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AUGUST 1961

Volume 30 Number 8

The International Journal of Medicine in Industry

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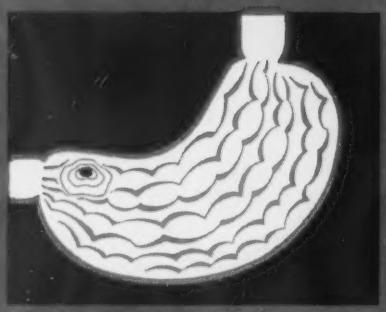

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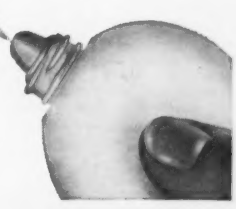

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The International Journal of Medicine in Industry

NUMBER 8
VOLUME XXX
AUGUST, 1961

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INDUSTRIAL MEDICINE AND SURGERY, The Journal of Medicine in Industry, consolidating "The Industrial Doctor," "Industrial Medicine," and "International Journal of Medicine and Surgery": Entered as second class matter August 28, 1941, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879. Reentered, October 3, 1949. Additional entry at Sheboygan, Wisconsin. Published on the fifth of each month by INDUSTRIAL MEDICINE PUBLISHING COMPANY, Miami, Florida. STEPHEN G. HALOS, Chairman; STEPHEN F. HALOS, President; HAROLD A. HOOPER, Treasurer; CAREY P. MCCORD, M.D., Editor; A. D. CLOUD, Editorial Consultant; LUCILLE H. GROSS, Circulation Manager; T. W. PINKARD, Production Manager. EXECUTIVE OFFICES, 400 S.W. 69th Avenue, Miami 44, Florida. PUBLICATION, EDITORIAL AND CIRCULATION matters should be addressed to P. O. Box 44-306, Miami 44. Subscriptions in United States $6.00 per year, $10.00 for 2 years; in Canada $8.00 per year, $14.00 for 2 years; in other countries $12.00 (U.S. Currency) per year, $20.00 for 2 years. Single copies $1.25. Title Registered in United States Patent Office. Registered Canada, 1942.

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PERSONAL NEWS AND NOTES

Robert P. Sim, M.D.

ROBERT P. SIM, M.D. became Medical Director of the Esso Standard Region, Humble Oil & Refining Company, on July 1, 1961. He succeeds LEO WADE, M.D., Esso Medical Director since 1951, who recently accepted a post with the Sloan-Kettering Institute for Cancer Research.

DR. SIM has been Assistant Esso Medical Director for marketing since 1953 and before July 1 was serving also as physician for the New York State marketing headquarters. He was physician for Esso's New Jersey marketing area in 1956 and 1957.

A 1934 graduate of the College of Physicians and Surgeons, Columbia University, DR. SIM served as intern and resident at three New York hospitals and joined the Medical Department at Esso headquarters in New York City in 1938. He has worked almost entirely since then on the development and administration of medical programs for Esso field marketing units from Maine to Louisiana. DR. SIM also earned a master's degree in public health from Columbia and served as a lieutenant commander in the Navy Medical Corps during World War II.

He is a member of the faculty of the Cornell University Medical College, New York City, a member of the executive committee of the New York State Society of Industrial Medicine, a member of the Council on Graduate and Undergraduate Education of the American College of Preventive Medicine and chairman of the council's subcommittee on occupational medicine, and a member of the committee on standards for safe driving of the Industrial Medical Association.

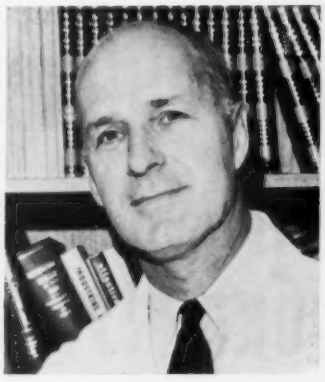
Appointment of WILLIAM L. SHIELDS, M.D., as a Chrysler Corporation Group Medical Director has been announced by M. W. JOCZ, M.D., Corporate Medical Director.

In his new position DR. SHIELDS will direct activities in Medical Group III, which includes Medical Departments at the Center Line, Detroit Tank, Highland Park, Marysville and Michigan Missile plants in the Detroit area, the Airtemp Division, Dayton, Ohio, and the Huntsville, Ala., Missile Operations.

Prior to this appointment, DR. SHIELDS was Senior Physician at the company's Highland Park Plant. He joined Chrysler Corporation in 1933. A graduate of the University of Toronto, he received his M.D. degree in 1924, after a year of internship at Detroit Memorial Hospital.

DR. SHIELDS is a Fellow in the American Industrial Medical Association, and a member of the Michigan Industrial Medical Association and the Detroit Industrial Medical Club.

Department of Public Health of the State of California announces the publication of *Occupational Disease in California Attributed to Pesticides and Agricultural Chemicals, 1959*. Complimentary copies are available upon request, within limitations of the supply, from the Bureau of Health Education, California State Department of Public Health, 2151 Berkeley Way, Berkeley 4, Cal.



Mac Roy Gasque, M.D.

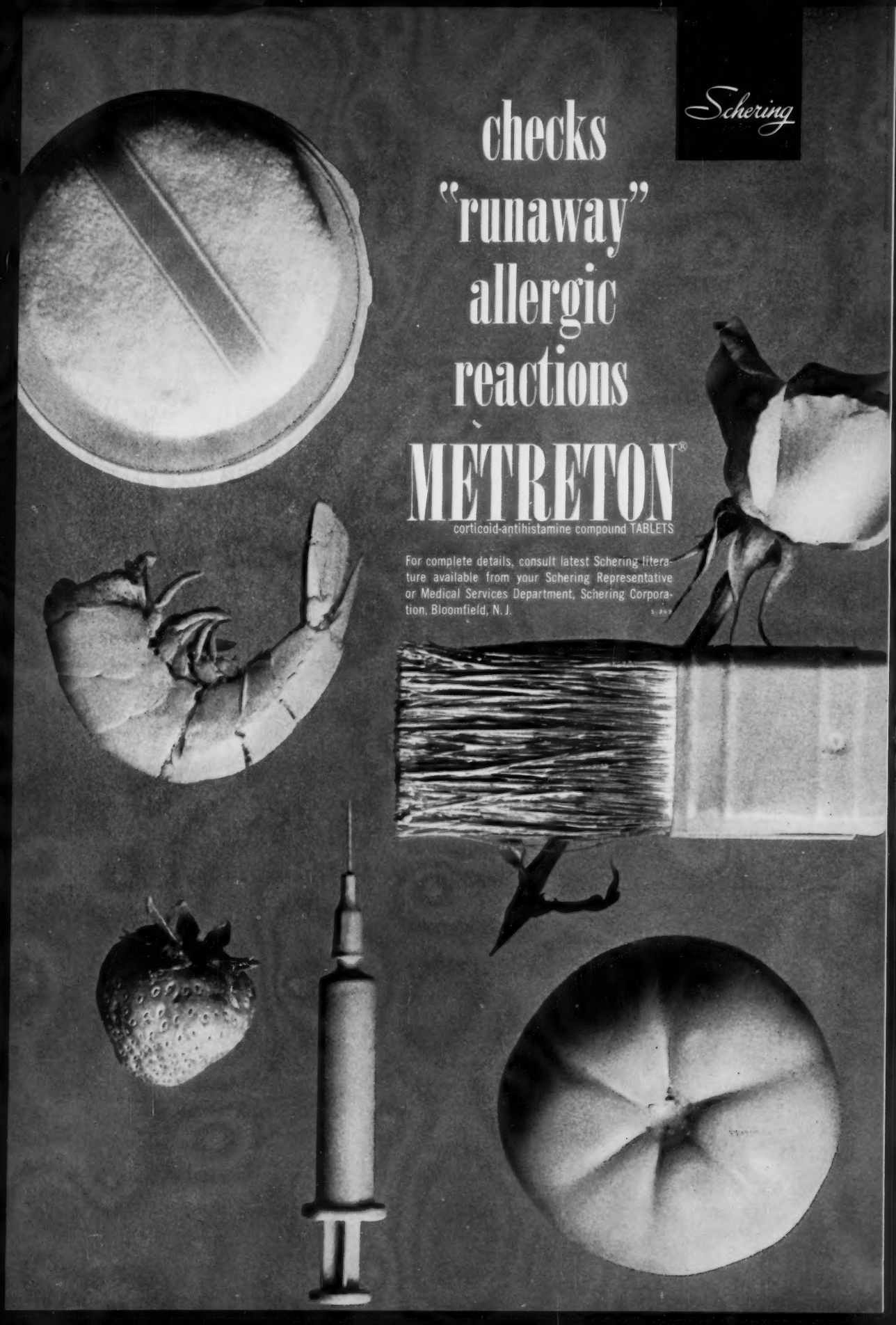
MAC ROY GASQUE, M.D., has been appointed to the newly created post of Medical Director of Olin Mathieson Chemical Corporation, GORDON GRAND, vice president for law and administration, announced. DR. GASQUE had been Medical Director of Olin's Ecusta and film operations at Pisgah Forest, N. C.

As Corporate Medical Director, DR. GASQUE will develop and implement modern industrial health programs for the corporation which emphasize preventive medicine and health promotion among employees. These programs, to be coordinated with Olin's safety program, will be tailored to meet individual plant and community needs.

DR. GASQUE received his M.D. degree from the University of Virginia Medical School in 1944 and spent several years in private practice before joining Olin in 1949.

DR. GASQUE is a Diplomate of the American Board of Preventive Medicine in Occupational Medicine.

DR. GASQUE holds a faculty appointment in the Department of Preventive Medicine at the Duke University Medical School and is a frequent lecturer at the Bowman Gray School of Medicine and the University of North Carolina.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The First Northeast Regional Symposium on Mental Health in Occupational Groups will be held from October 22 through 27, 1961, at the Institute of Living in Hartford, Connecticut. The first of a series of symposia planned by the Committee on Mental Health of the Industrial Medical Association, this five day course will be sponsored by the Institute of Living and the American Psychiatric Association.

The physicians attending the symposium will have the opportunity to observe the activities, including the reseach and teaching programs, at the Institute of Living, one of the nation's largest and oldest psychiatric hospitals.

Faculty for the course from the Institute Staff will include FRANCIS J. BRACELAND, M.D., Psychiatrist in Chief, JOHN DONNELLY, M.D., Medical Director; BERNARD C. GLUECK, JR., M.D., Director of Research, and others. The number of participants has been limited to 20, in order to assure the active participation of all attendees.

MARVIN R. ALBERG, M.D., of Chicago, Illinois, has been appointed Assistant Medical Director of the Business Men's Assurance Company of America. Formerly associated with the Standard Oil Company of Indiana, DR. ALBERG received his M.D. degree from the University of Colorado School of Medicine in 1947, and a Master's Degree in Public Health from the University of Michigan.

Died

WILLIAM DUNCAN MC NALLY, M.D., 78, in Mobile, Ala., on June 29, 1961. One of the nation's foremost experts in the field of toxicology, and an associate editor of *Industrial Medicine and Surgery* from 1935 to 1950, in 1913 DR. MC NALLY established the first toxicological laboratory in this country for the coroner's office in Chicago. He served as toxicologist for Cook County, Ill., from 1913 to 1929; and for the Chicago Health Department from 1929 to 1932, and from 1941 to 1947. In this position, he urged abolition of coroners' inquests in favor of the medical examiner's method for determining causes of death.

A native of Saginaw, Michigan, DR. MC NALLY graduated from the University of Michigan in 1905, and after graduate study at the University of Illinois and the University of Chicago, he taught chemistry at the University of Illinois. Subsequently, he was chief chemist for Armour & Co. before becoming chief chemist and then toxicologist for the Cook County Health Department. At the same time, he completed medical studies at Rush Medical College in 1920.

DR. MC NALLY was Professor of Toxicology and Industrial Hygiene at Rush Medical College, where he taught for 28 years, and was also Professor of Toxicology at the University of Illinois Medical School. In addition, he was attending toxicologist at several hospitals in the Chicago area and was consulting toxicologist for numerous industrial and insurance companies.

DR. MC NALLY was the author of two textbooks on toxicology and was a frequent contributor to medical journals of papers on poisons and toxicological hazards, particularly those in industry. His special interests concerned industrial manganese and carbon monoxide poisoning, and silicosis.

Since 1950, DR. MC NALLY had been living in retirement in Mobile, but he maintained an active interest in professional activities, as president of the Mobile-Pensacola Section of the American Chemical Society. He was a Fellow of the American Medical Association, and a member of the Chicago Medical Society, the Illinois State Medical Society, the American Chemical Society, and the Chicago Chemical Society. In 1952, he was elected to the International Academy of Legal and Social Medicine at Brussels, Belgium.

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*Combes, F. C.: Ind. Med. & Surg. 30:29-34 (Jan.) 1961.

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References: (1) Sulzberger, M. B.; Wolf, J.; Witten, V. H., and Kopf, A. W.: Dermatology: Diagnosis and Treatment, ed. 2, Chicago, The Year Book Publishers, Inc., 1961, pp. 44-45. (2) Combes, F. C.: New York Physician & Am. Med. 23:3, 1948.

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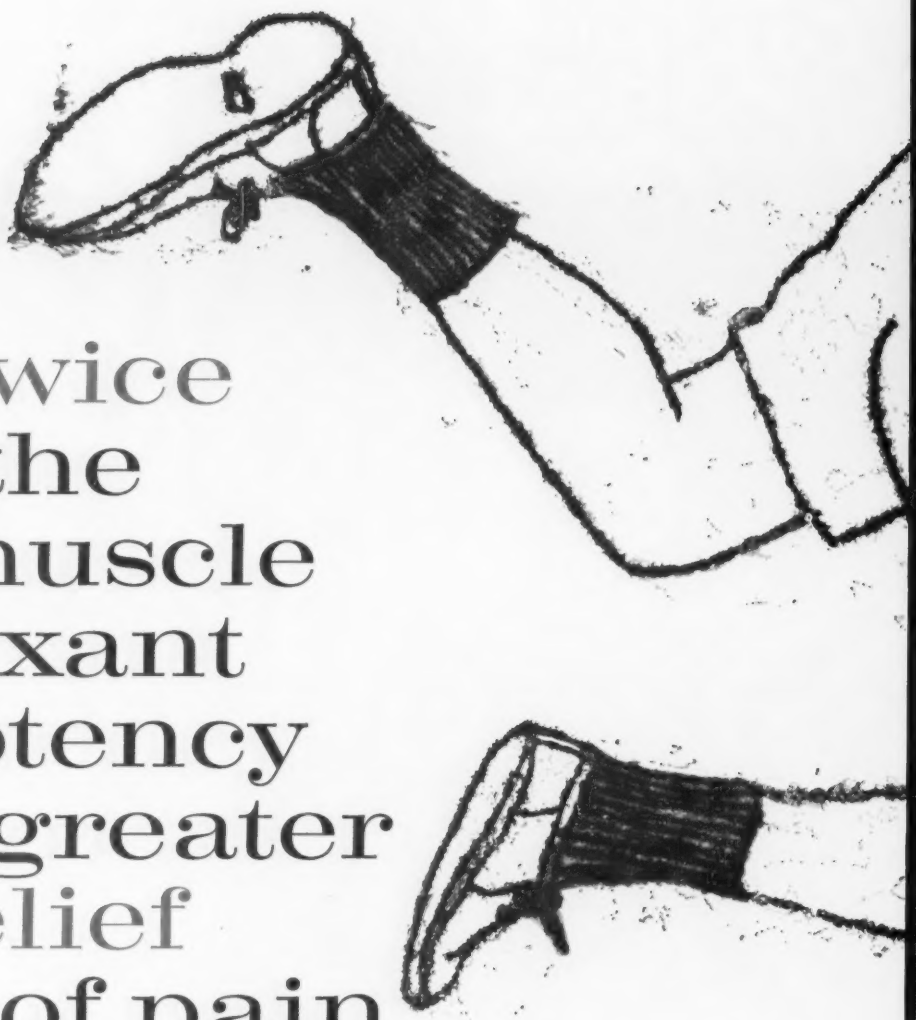

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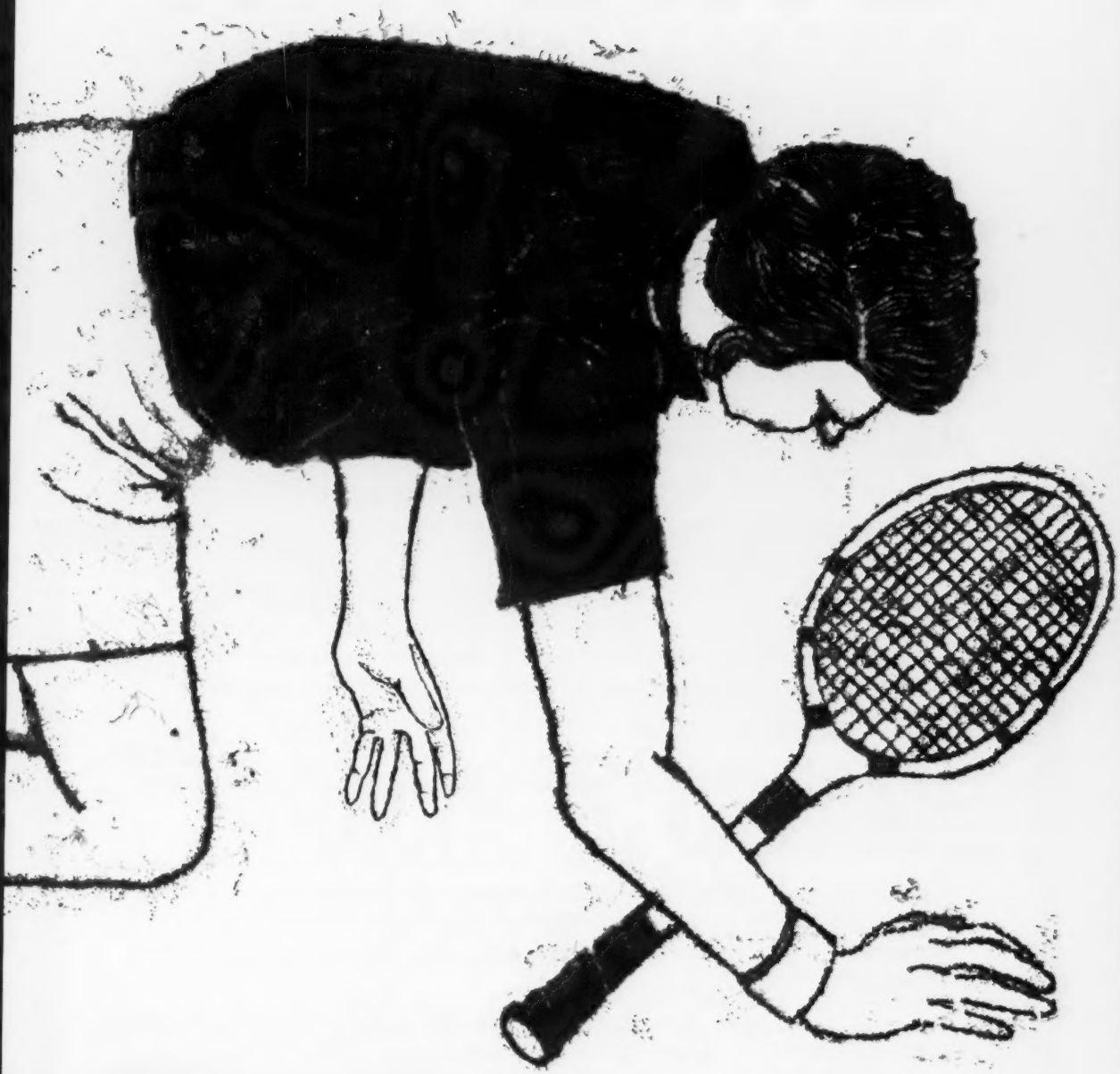

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References: (1) Settel, E.: Clin. Med. *6*:1373, 1959. (2) Peak, W. P., and Smith, P. T.: Penn. Med. J. *63*:833, 1960. (3) Mayle, F. C.; Sullivan, P. D., and Auth, T. L.: Med. Ann. D. C. *28*:499, 1959. (4) Roth, J. L. A.: Med. Clin. N. Amer. *41*:1517, 1957. (5) Batterman, R. C., and Grossman, A. J.: J. A. M. A. *159*:1619 (Dec. 24) 1955.

†U.S. Patent No. 2,895,877

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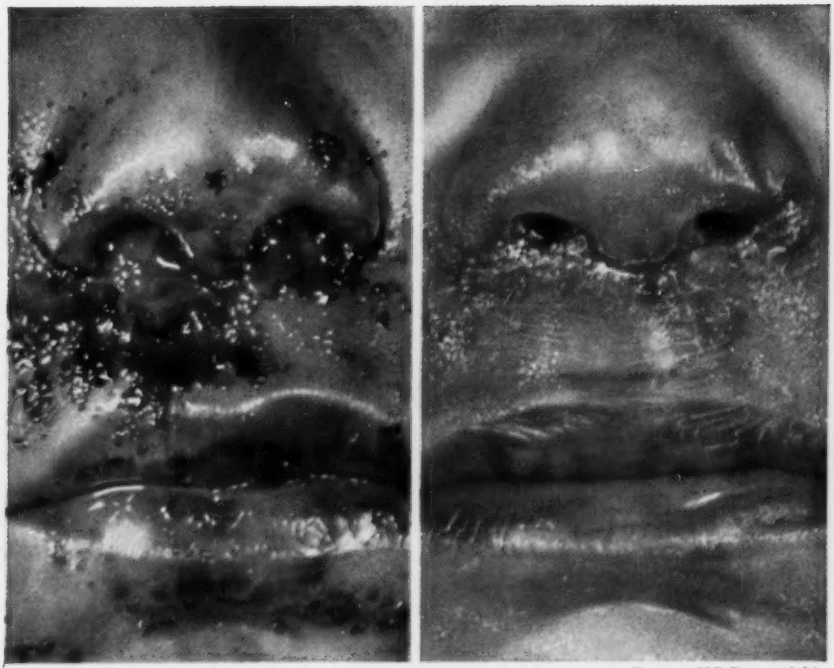

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1. Morani, A. D.: J. Med. Women's Fed. *42*:12, 1960. 2. Cigarroa, L. G.: J. Internat. Coll. Surgeons *34*:442, 1960. 3. Moore, F. T.: Brit. J. Plastic Surg. *11*:335, 1959. 4. Personal Communications to the Medical Department, Armour Pharmaceutical Company, 1959.

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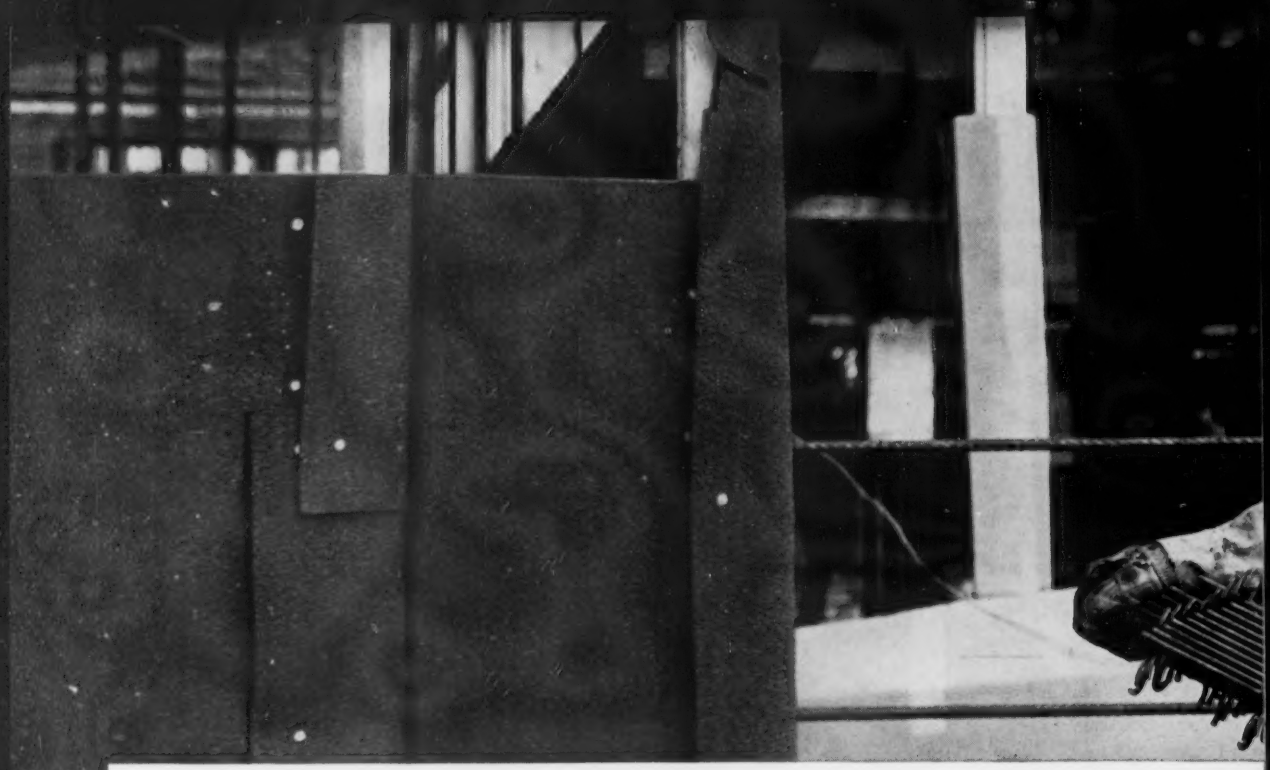

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Soma is unique because it combines the properties of an effective muscle relaxant and an independent analgesic in *a single drug.* Unlike most other muscle relaxants, which can only relax muscle tension, Soma attacks both phases of the pain-spasm cycle at the same time.

Thus with Soma, you can break up both pain and spasm fast, effectively . . . help give your patient the two things he wants most: relief from pain and rapid return to full activity.

Soma is notably safe. Side effects are rare. Drowsiness may occur, but usually only with higher dosages. Soma is available in 350 mg. tablets. Usual dosage is 1 tablet q.i.d.

The muscle relaxant with an independent pain-relieving action

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(carisoprodol, Wallace)

Wallace Laboratories, Cranbury, New Jersey

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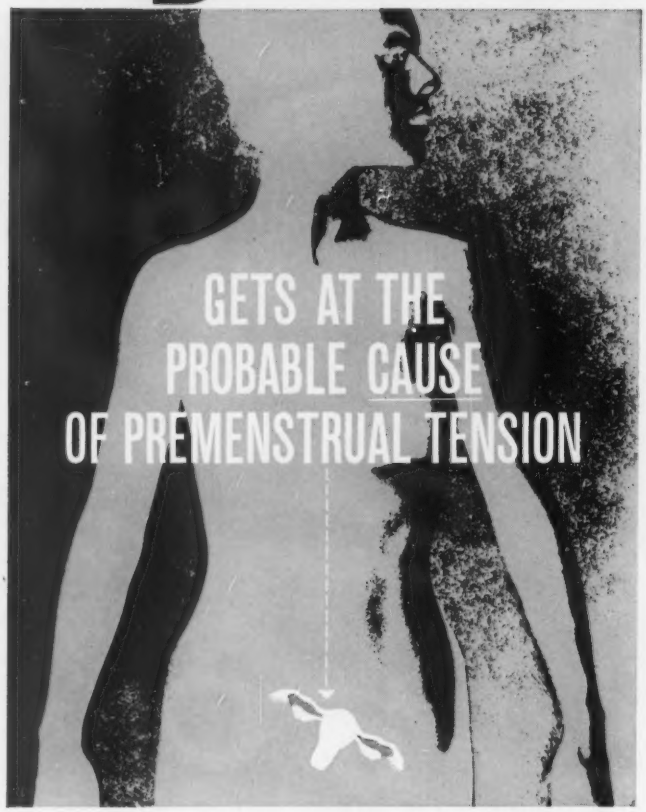
Kestler reports in J.A.M.A. (April 30, 1960) that conventionally treated low-back syndrome patients required an average of 41 days for full recovery (range: 3 to 90 days). The addition of Soma therapy in this comparative investigation reduced the average to 11.5 days (range: 2 to 21 days). With Soma, patients averaged full recovery 30 days sooner.

Upjohn

Cȳtran†



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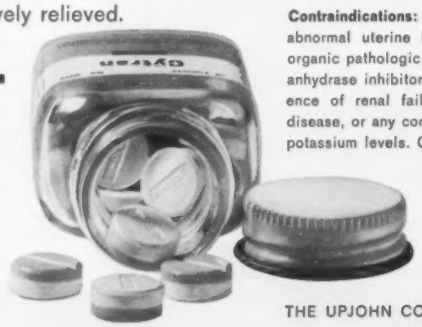
CORRECTIVE THERAPY Because Cȳtran contains the new progestin, Provera*, you can now reach the probable cause of premenstrual tension—hormonal imbalance. The estrogen-progesterone ratio is adjusted to more normal premenstrual balance. Abdominal discomfort, shakiness, fatigue—symptoms incompletely controlled by mere symptomatic treatments—are often effectively relieved.

to comfort the patient...

SYMPTOMATIC THERAPY An effective diuretic (Cardrase*) and a mild tranquilizer (Levanil*) afford symptomatic relief during the time required to effect basic correction. They also supplement the activity of Provera in those patients in whom restoration of hormone balance does not completely eliminate edema and anxiety/tension.



Each tablet contains:

Provera (medroxyprogesterone acetate)	2.5 mg.
Cardrase (ethoxzolamide)	35 mg.
Levanil (ectylurea)	300 mg.

Usual dosage: 1 to 2 tablets daily, 5-10 days before the period.

Supplied: As layered tablets in bottles of 20 and 100.

Precautions: Side effects following the use of Cȳtran are rare. The patient should be observed for possible sensitivity to one or more of the components. Drowsiness, if seen, may be relieved by decreasing the dosage.

Contraindications: Cȳtran should not be used in patients with abnormal uterine bleeding until malignancy and all other organic pathologic conditions have been ruled out. Carbonic anhydrase inhibitors should not be administered in the presence of renal failure, hyperchloremic acidosis, Addison's disease, or any condition involving depressed sodium and/or potassium levels. Caution must be observed in the presence of symptomatic hepatic cirrhosis as acidosis may develop. Tranquilizing agents, generally, are not indicated in true depressive states without concomitant anxiety.

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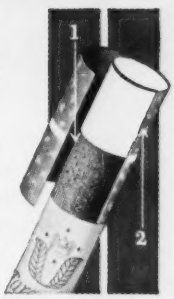

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IMS

Ionizing Radiation in the Space Environment

• MAXWELL DAUER, Ph.D.
Associate Professor of Radiation Physics
University of Miami School of Medicine
Miami, Florida

Introduction

Ionizing radiation in the space environment poses many challenging problems which must be considered in the engineering design and and operation of manned space craft so that the radiation hazards are minimized. Ultimate use of nuclear systems as a primary source of propulsion or for accessory power will impose additional requirements to shield space crews against this type of radiation.

Within the orbital atmosphere, the radiation levels are minimal for earth-circling vehicles or satellites, and pose no significant shielding problems. However, beyond the orbital atmosphere is the electromagnetic and corpuscular radiations from the Van Allen or Great Radiation Belts, cosmic radiation, and the extremely dangerous bursts of protons released by solar flares. Practical protection against cosmic and Van Allen radiations can be accomplished by proper use and arrangement of the vehicle components and structures taking advantage of self-shielding. For continued operation in the inner Van Allen belt, special shielding will be required. Use of appropriate shielding materials, shield configurations, and dependable data on the frequency of occurrence, duration, and intensity of solar proton radiation will be necessary to provide the essential information to minimize the proton radiation hazards of the

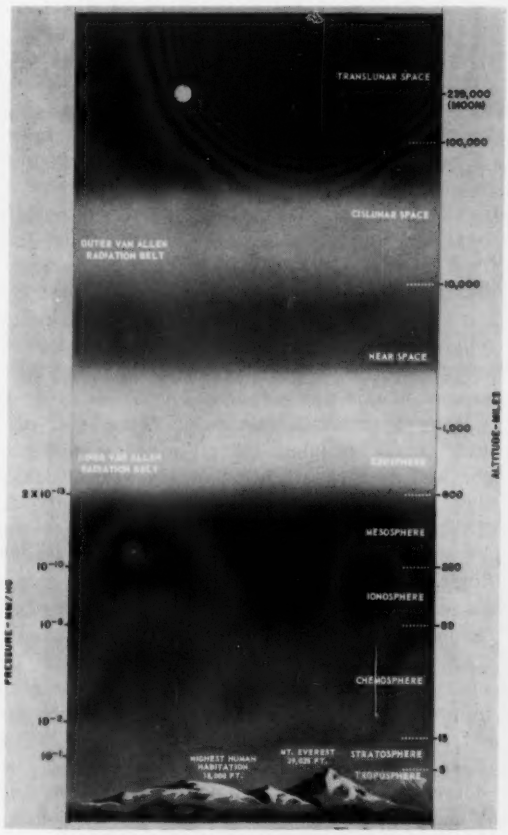

Figure 1
Profile of Atmosphere

Presented at the Third Inter-American Conference on Occupational Medicine and Toxicology, University of Miami School of Medicine, Miami, Florida, August 7, 1961.

TABLE I.
SUMMARY OF SPACE ENVIRONMENTS

Parameter	Location				
	Earth	Moon	Venus	Mars	Interplanetary Space
Pressure mm Hg	760 to 10^{-11}	10^{-10} to 10^{-11}	760 at cloud tops to 10^{-11}	76 to 10^{-11}	10^{-11}
Atmospheric Composition	N_2,O_2,A,H_2O	Maybe SO_2	CO_2,A,N_2,H_2O	N_2,A,CO_2	H
Solar Radiation w/m²	1400 $\lambda = 10\text{-}10^5$A	1400 10-10^5A	2690 1-10^5A	600 1-10^5A	Variable
Meteoritic Particles	3-4 microns	Dust			Potential Hazard
Cosmic Radiation	0.03 rem/yr (See Table II)				85% Protons) 14% Alphas 1% other nuclei
Total Radiation Background	0.1 rem/yr. Outer Belt e				
Van Allen Radiation	Inner Belt H^+ (See Table III)				
Magnetic Fields gauss	0.3 to 10^{-6}	10^{-6}	Same as Earth	Less than Earth	10^{-2} to 10^{-8}
Gravity g's	1	0.164	0.85	0.38	0 while in geocentric or heliocentric orbits

outer space environment. The ability to predict and shield against solar flares will be an important factor in the ultimate achievement of flights in outer space with a minimum of radiobiological effect. The purpose of this paper is to summarize the current status of the space radiation problem as it affects manned flight.

Man is now engaged in one of the most exciting and challenging undertakings in history, in his penetration of the earth's atmosphere at suborbital and orbital levels circling the earth to be followed in the future by interplanetary and galactic space travel. Figure 1 is a schematic profile of the atmospheric levels in relationship to altitude and pressure. Also represented are the Van Allen Radiation Belts. There is no doubt that it requires considerable creative engineering skill and ingenuity to design a suitable and reliable space vehicle with the proper biological and psychological environment to insure man's success in this new venture.

Manned flight in the outer terrestrial, cislunar, and translunar space regions is only one phase of man's exploration of space. Translunar space is a logical area for manned space craft or stations to operate. This will provide the means for simulation, training, and testing of extended flight mission problems preparatory for interplanetary trips in vehicles propelled by improved chemical, nuclear, or other exotic power sources.

In addition to the requirements imposed by environmental radiation, it is important to keep this hazard in proper perspective with the other extraterrestrial extremes of outer space. The other environmental factors which must be considered as a part of the launching, flight and re-entry phases of a manned space mission, in addition to ionizing radiation, include:

1. Extended periods of weightlessness
2. Variations in temperature
3. Extreme accelerations and decelerations
4. Low pressures
5. Extreme vibrations and noise levels
6. Eating, sleeping, working and accomplishing normal body functions under hostile environmental conditions
7. Extended periods of isolation, confinement and mental stress resulting in boredom or apathy

The synergistic effects of weightlessness, acceleration, and deceleration, for example, under conditions of prolonged flight, may have significant radiobiological effects which may alter man's response to radiation. A concept of the physical parameters of the space environment is presented as a concise summary in Table I.

Cosmic Radiation

The investigation of cosmic ray phenomena has led to many important discoveries of fundamental nuclear particles and radiations. Early in the twentieth century, it was noted that the simple electroscope would gradually discharge although no known radiations were present. At first several hypotheses were developed to explain this phenomena. Eventually, it was demonstrated that ionization varied with altitude and was caused by extremely penetrating radiation falling upon the earth from the outside. These observations by Hess and by Kolhorster,[1] supported by the work of many investigators,[2] constituted the discovery of "cosmic rays."

As a result of many years of cosmic research made at the top of earth's atmosphere using high altitude balloons, rockets, and satellites, the energy spectrum and particle composition of the primary radiation are now quite well known.[3] These particles consist of about 85% protons,

13% alpha particles and less than 2% higher atomic number particles, all stripped of their electrons and moving isotropically at very high velocities. Recent measurements[4] place the free-space flux of cosmic ray particles at 2.5 cm²/sec. at an ionization rate inside approximately 1 g/cm² of low-atomic number shielding material at 0.6 mr/hr. Galactic cosmic radiation is modified during a solar cycle resulting in an intensity decrease as solar activity increases and is known as a "Forbush decrease."[5]

At sea level, the radiation dose to the general population from cosmic radiation is about 30 mrads per year and represents about 30% of the average natural background radiation dose. The cosmic radiation detected on the earth consists of about 80% mesons, about 20% electrons and about 0.05% protons. The intensity of cosmic radiation increases with altitude as a result of less air absorption and varies depending upon the geomagnetic latitude under the influence of the earth's magnetic field as shown in Figure 2. As reported by Schaefer and Golden,[6] at about 15 miles above the earth's surface at 55 degrees north latitude, the dose rate is approximately 15 millirads per day. At an altitude of 100 to 200 miles, the dose rate is about 0.5 millirads per hour.

The radiation dose due to cosmic radiation received while flying in a jet plane at an altitude of 35,000 feet at 55 degrees north latitude is six millirads for 24 hours of exposure. It must be remembered that the sea level dose from cosmic radiation depends upon location and altitude. To place this dose in proper perspective, it is helpful to compare the cosmic radiation dose with other radiations received by man on earth as shown in Table II.

At 310 miles above the earth's surface, the electron particles do not exceed 1 mev.[7] At this altitude, an astronaut will be completely protected from this source of radiation by as little as 0.15 cm of aluminum (400 mg/cm²). The ordinary structural thickness of the walls of the vehicle and even the clothing worn by the astronaut will stop 1 mev electrons. The bremsstrahlung or soft x-rays which are produced are so negligible that they can be disregarded.

Based upon present radiation exposure guides, as specified by the National Bureau of Standards Handbook 69[10] and the Federal Radiation Council,[11] there should be no significant somatic injury to individuals below the Inner Van Allen Belt on earth suborbital trajectories. While whole body ionization tissue dosage values for cosmic radiation are not serious, there still exists some real and disturbing questions as to the effect of single hits of densely ionizing, heavy nuclei or "microbeams" which will produce direct destruction of vital cellular components. It is conceivable that repeated bombardment of specialized cells or organs by intense heavy cosmic radiations may have some functional significance. Chase[12] observed permanent graying of hairs in black mice exposed to cosmic radiation at high altitude as representative of this type of injury. Tobias and Brustad[13] have reported on the various radiobiological studies with heavy ions simulating cosmic ray nuclei. These studies

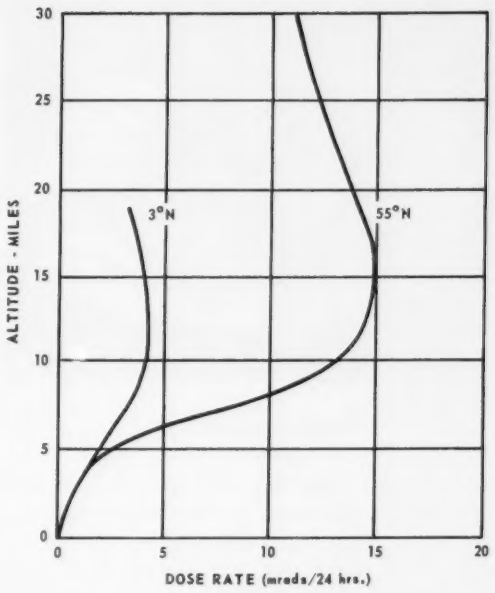

Figure 2
Variation of Cosmic Dose Rate With Altitude

TABLE II.
ESTIMATED AVERAGE ANNUAL GONAD EXPOSURES IN UNITED STATES[8,9]

Natural Sources:	Millirems
A. External to the body:	
1. Cosmic radiation	28.0
2. From the earth	47.0
3. From building materials	3.0
B. Inside the body:	
1. Inhalation of air	2.0
2. Elements found naturally in people	21.0
Total, natural sources	101.0
Man-Made Sources:	
A. Medical procedures:	
1. Diagnostic X-rays	150.0
2. Radiotherapy X-ray, radioisotopes	10.0
3. Internal diagnosis, therapy	1.0
Subtotal	161.0
B. Atomic energy workers	0.1
C. Luminous watch dials, television tubes, shoe fluoroscopes, radioactive industrial wastes, etc.	1.0
D. Radioactive fallout:	
1. External dose	3.0
2. Internal dose	1.0
Subtotal	5.1
Total, man-made sources	166.1
Over-all Total	267.1

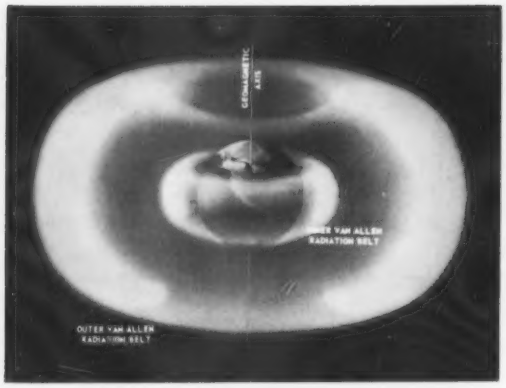

Figure 3
Van Allen Radiation Belts

indicate that there is intense ionization of cells and tissues traversed by the radiation which results in irreparable damage and cell death.

Of vital importance for an understanding of the radiobiological significance of space radiation and for the planning of shielding requirements is the relative biological effectiveness or RBE of the various types of radiation. The response of tissue to ionizing radiation is based upon the effects of 250 kvp x-rays expressed in roentgens. Radiation of this energy has a linear energy transfer or LET of about 3.5 kev per micron of soft tissue. This relationship provides the basis or standard for the establishment of tolerable radiation exposure levels.

The biological response to the different types of radiation, such as x-rays and gamma rays as compared with electrons or beta rays, alpha rays, protons, or neutrons, is determined by the nature and amount of tissue, energy and character of the radiation and the degree of ionization, damage or destruction produced by the radiation as it traverses the biological material.

The relative biological effectiveness or RBE is a factor used to express the difference in biological effects by various radiations compared with the response produced by x-rays or gamma radiation. Rem (roentgen equivalent man) is the unit used to express the dose of a particular radiation which will result in a biological response similar to that produced by one roentgen of 250 kvp x-rays. Although the roentgen is loosely used to express radiation, it should be limited to x-rays and gamma rays below three mev. A roentgen is equivalent to 83.9 ergs absorbed by each gram of air. The absorption of 100 ergs of energy in one gram of tissue (or material) is the rad and is used to express absorbed dose.

The RBE for heavily ionizing particles like alpha particles is 10; for neutrons, it is 10; and for electrons below 30 kev, it is 1.7. The RBE for beta particles, x-rays and gamma rays is 1. For protons up to 10 mev, a value of 10 is given by Hines and Brownell.[14] In the range of 10 to 100 mev protons, the RBE is assumed to decrease gradually to one. From 100 mev upwards, it is considered to remain at one. Thus, if it is desired to express the total dose to which a man would be exposed from different types of radiation, the common denominator of expression would be in terms of rem. Assuming that there is an exposure to different radiations, the total dose could be expressed by using the relationship of:

$$\text{Rem} = \text{Rads} \times \text{RBE}$$

and the following conversions to rem would be possible:

	RBE		*REM*
10 rads of beta radiation X	1	=	10
10 rads of neutron radiation X	10	=	100
10 rads of x-radiation X	1	=	10
10 rads of proton radiation X	10	=	100
		Total radiation in rem	= 220

Van Allen Radiation Belts

One of the most significant events resulting from exploration of space was the discovery in 1958 by Van Allen and his associates[15] of intense zones of radiation trapped by the earth's magnetic fields. The Van Allen zones consist of two belts of radiation extending in doughnut fashion around the earth centered over the geomagnetic equator. Figure 3 is a diagrammatic representation of the two radiation belts. It should be noted that at the geomagnetic poles there appear openings or "polar hatches" which are relatively free of radiation. This configuration of the Van Allen radiation belts will undoubtedly have an important effect on space vehicle trajectories and shielding requirements.

Table III includes a summary of the type, energies and flux of the particles in the Van Allen Radiation Belts.

The observed spectrum and the composition of the radiation in the inner zone appear consistent with the neutron-decay hypothesis of origin of the radiation belts.[16] This theory depends upon the ability of neutrons from cosmic-ray induced nuclear disintegrations in the atmosphere to

TABLE III.
FLUX OF RADIATION PARTICLES IN VAN ALLEN BELTS

Particles	Energy	Flux (cm^2/sec)
	Inner Belt — 2000 Miles	
Protons	>40 mev	$\sim 2 \times 10^4$
Electrons	>20 kev	$\sim 2 \times 10^9$
Electrons	>600 kev	$\sim 1 \times 10^7$
	Outer Belt — 15,000 Miles	
Electrons	>20 kev	1×10^{11}
Electrons	>200 kev	$>1 \times 10^8$
Protons	>60 mev	1×10^2

move outwards through the geomagnetic field without deflection until they undergo radioactive decay.

The decay products of a neutron (half-life at rest 11.7 min) are an electron, a proton and a neutrino. The kinetic energy of the proton is comparable to that of its parent neutron; the electron has a well known beta decay spectrum (upper limit 782 kev for a neutron at rest), and the neutrino does not contribute to the observed geophysical phenomena.

There is little doubt that the great outer zone and the immense variety of associated geophysical effects are attributable to solar gas, injected into trapped orbits in the geomagnetic field. The site and mechanism of their accelerations to the energies observed still constitute a major unsettled problem. It has been suggested that the Van Allen Belts serve as a sort of "storage bin" in which solar energy is trapped for a time before it is released to the atmosphere.

The inner Van Allen Belt begins at about 500 miles above the earth and extends out to about 5,000 miles. Astronauts in orbital paths circling the earth below the inner belt will be outside the intense radiation of this zone. The inner belt consists of protons and electrons with energies as shown in Table III. Van Allen and Frank[17] reported exposure rates at the peak of the inner belt of 5-10 r/hr if due to electrons or x-rays and 50-100 r/hr if due to protons. Naugle[18] estimates that an unshielded man would receive 20 rem per hour at the heart of the inner belt and approximately 200 rem per hour of soft radiation at the heart of the outer belt.

The outer Van Allen belt is a torus with a banana-shaped cross section. Its lower edge is considered to be approximately along a geomagnetic force line which intersects the equator. It extends out from about 10,000 to 30,000 miles above the earth. The intensity as well as the extent of the zone is highly variable especially during solar flares. It consists primarily of electrons with some protons. The average radiation level in this zone is about 200 rem/hr with maximum peaks exceeding these levels considerably. Since the flux in the outer belt is primarily due to electrons and the resultant bremsstrahlung, structural materials of the vehicles are adequate to reduce this by a factor of 10^3 or less.

Since the Van Allen Belts are confined to a relatively small region of space, it is possible that a vehicle might avoid most of the intense Van Allen radiation by escaping from the earth in the polar regions (Figure 4). However, reentry with passage through the Van Allen Belts would continue to pose a problem. Rapid passage through the belts would minimize the dose considerably.

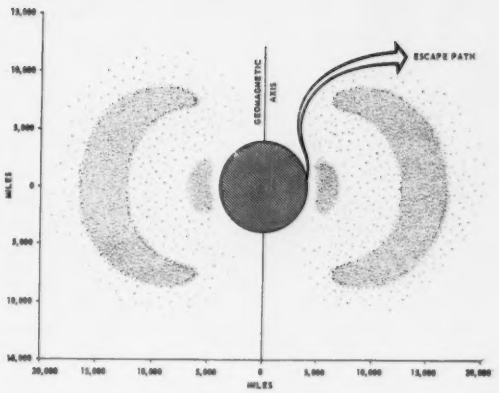

Figure 4
Escape Trajectory

Solar Flare Radiation

The most serious potential hazard to man in extraterrestrial travel is due to proton beams from solar flares. Following solar flares which occur on the sun's visible disc, intense beams of protons are observed in outer space with increases in protons reaching the earth. This stream of protons continues to arrive for as long as 11 days.[19] Unlike the Van Allen radiations, these particles are not restricted to a small region of space that can be avoided or traversed rapidly. It is estimated that the dose rate may rise as high as 10^3 rads/hr.[20] Since solar proton outbursts are intermittent in nature, the integrated dose is most important. The radiation after a flare may remain at high levels for a few hours or days. The energies of these particles extend from 20 to 500 mev.

The flares which provide the source of protons are usually solar eruptions. Their appearance makes a storm on the surface of the sun. Warnings regarding the occurrence of these eruptions can be obtained by visible observations of the solar flare and increased disturbances or blackouts in radio communications, magnetic storms and auroral displays. Disturbances in radio communications usually provide the earliest warning that a solar flare is in progress. Since the solar protons move across interplanetary space at the rate of about 1,000 miles per second while the visible and ultraviolet radiations (which cause radio disturbances) travel with the speed of light, the time lag of the arrival of protons may be of value for radiation protection purposes. This time differential may range from 15 to 40 minutes or more. In some cases, the delay may be as much as 10 hours. The arrival of protons at the earth's surface, therefore, occurs sometimes near or after the flare peak's intensity.

In the five year period from 1956 to 1960, there

were over 40 distinct solar proton events of which at least five reached lethal intensities for man.[19] The intensity of the solar activity with resultant solar flares follows the well-known pattern referred to as the "eleven year sunspot cycle." Anderson[19] has made a study of solar flares for the purpose of using the data for the prediction of events. If a successful forecasting program could be developed, it would allow space vehicles and their occupants to avoid exposure to large radiation fluxes and, at the same time, permit space exploration without operational restriction. A further important benefit of a reliable forecasting system would be that heavy radiation shields would be unnecessary. It has been found that flares on the sun nearly always appear in a sunspot group that has had, very early in its development, a large unbroken penumbral area. These flares occurred no earlier than two days after the appearance of a penumbra. Based upon current observations, it appears that no reliable forecast can be made at the present time to guarantee avoidance of a solar flare for space flights lasting longer than four days. For flights of longer duration, shielding appears to be the only feasible means for minimizing radiation exposure during periods of high sunspot activity.

Radiation Shielding

The most important factor in radiation shielding for manned space vehicles is the provision of the required amount of radiation protection with a minimum of added weight. This means selection on a minimum weight basis of the best absorbing materials for the space radiations to be encountered. It must be remembered that within a vehicle, fuel, equipment, and other structures and supplies can be used effectively to gain the maximum shielding benefit. The equipment layout and inherent shielding characteristics of these materials should be used to the utmost to avoid adding any unnecessary weight.

For space vehicles circling the earth below the inner Van Allen Belt, ordinary materials used in the construction of the vehicle are sufficient for the dose levels encountered. Within the inner belt, the primary hazard is from the protons with energies above 40 mev. Within the outer belt, the primary hazard is from the bremsstrahlung released into the interior of the vehicle produced by the electron flux impacting on the skin of the vehicle. The protons released from solar flares are very energetic and range considerably in intensity. Since the protons of the inner Van Allen belt and from the solar proton bursts require additional shielding, protection must be based upon those proton absorbing materials which will result in the minimum amount of weight.

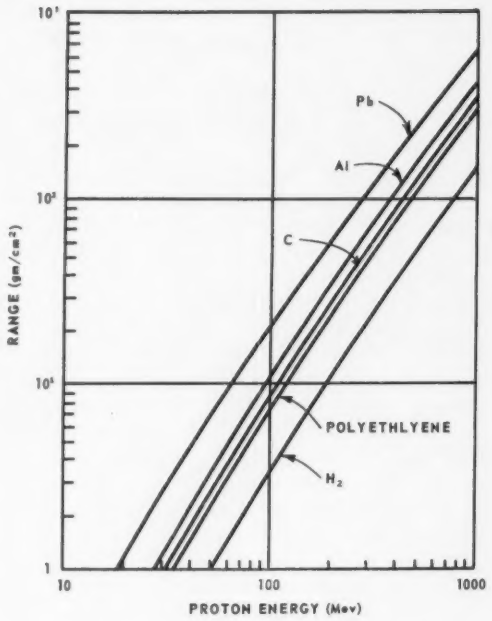

Figure 5
Proton Energy — Range Curves

With regard to electron shielding, the requirements are minimal and impose no severe requirements. Electrons dissipate their energy by two mechanisms[21] when passing through matter, producing ionization and bremsstrahlung radiation. In the process of ionization, high speed electrons collide with the orbital electrons of the substance through which they pass with the production of ion pairs. Bremsstrahlung radiation is electromagnetic energy, such as soft x-rays, which are released when electrons interact with the field of the atomic nucleus. It depends on the mass and energy of the impacting electron as well as the atomic number of the target nucleus.

As protons penetrate matter, they lose energy primarily by ionization and excitation of the target atoms. Depending upon the energy of the protons, they may give up their energy in the impacted atoms or traverse it and emerge with decreased energy. It is during this process that the protons are destructive to cells and tissue and produce deleterious biological effects.

In Figure 5, the range-energy relations for protons with energies from 1 to 1000 mev for a number of materials have been plotted. Comparison of these curves indicate that low-Z materials, such as hydrogen and carbon, are superior. Lead is a rather poor shield against high-energy protons of the type existing in space.

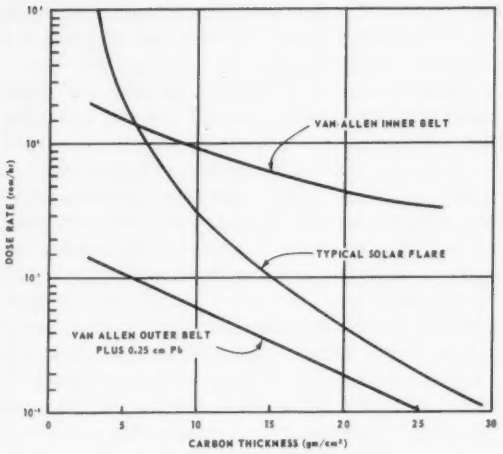

Figure 6
Dose Rate and Shield Requirements

Carbon is superior to aluminum. Carbon may be improved by combining it with hydrogen to form polyethylene.

Although shield weight is important, there are other aspects to be considered. These include structural strength of the shield to withstand the space environment, ease of fabrication and desirability to utilize the shield for its structural characteristics. Although carbon is effective as a proton shield, polyethylene and lead are most desirable as a shield for protection in a nuclear-propelled craft while aluminum has excellent structural features. The ideal shielding material, then, for nuclear propulsion vehicles will be a combination of low-Z materials with high-Z materials such as lead or depleted uranium. From an engineering standpoint, materials which also possess high temperature characteristics are preferred.

Figure 6 illustrates the shielding requirements at certain dose rates for vehicles designed for specific missions based upon various concepts and shielding configurations.[7,22,23,24,25] The shield used for protection against protons in the inner Van Allen Belt is plotted to indicate the amount of carbon in grams per cm² required to reduce the radiation to a specific dose rate expressed in rem per hour. Likewise, the shielding requirements for protection against outer belt radiation is plotted.

It should be noted also that the use of an added inner layer of 0.25 cm of lead serves to absorb the bremsstrahlung produced by the electron flux which predominates in this zone. It is evident that more shielding is required for the inner belt than for the outer belt. Using a shield of 10 gm/cm² for the outer belt, the dose rate is 9.5 rem/hr while for the inner belt with

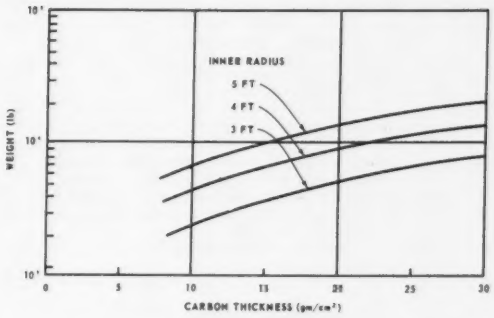

Figure 7
Weights of Spherical Shields

a 10 gm/cm² shield combined with 0.25 cm lead, the dose rate is 0.65 rem/hr. For a typical solar flare consisting primarily of energetic protons, with a 10 gm/cm² carbon shield the dose rate is 3.2 rem/hr. The integrated dose for a typical flare would be based upon the total exposure of radiation extending over a period of about 25 to 30 hours. On this basis, the total integrated radiation dose to an astronaut shielded with 10 gm/cm² of carbon or its equivalent, would amount to about 100 rem for a single typical solar flare burst.

To determine the weight for the various carbon shields with a spherical radius of three, four, or five feet, Figure 7 can be used. A three foot spherical shield using 10 gm/cm² would weigh 2500 lbs. while a four foot 10 gm/cm² shield would weigh about 4500 lbs. Where the 0.25 cm lead is added to the outer belt shield, there is an 0.8% increase in the total weight of the shield.

Based upon the type of mission, it is clear that for an astronaut orbiting below the Van Allen belts, the radiation levels are minimal, and require no special shielding and present no serious radiation health hazard. The highly energetic cosmic radiations which may traverse by chance vital biological areas are difficult to shield against and would require impractical and heavy shields. The Van Allen belts can be adequately shielded for specific and limited missions. For space missions in outer space, the Van Allen belts can be traversed rapidly and under these conditions, the controlling factor will be shielding for solar protons.

Fichtel[26] has proposed the use of a specially designed shield or "storm cellar" to be available for an astronaut aboard a spacecraft as protection against the radiation from a solar flare. This would be a rectangular box made of 8 gm/cm² material weighing about 1,000 pounds. It would be large enough to accommodate a man with food for about 24 to 48 hours during the critical phase of a solar proton flare.

TABLE IV.
RADIATION EXPOSURES-REM

0.1	Annual background radiation
0.5	Annual dose for general public
5.0	Annual dose for radiation workers; space vehicle design per mission; annual space cosmic radiation
25	Radiation workers emergency dose; special space mission dose; Van Allen Inner Belt (dose/hr)
50	First identifiable signs of radiation effects
100	Radiation sickness appears; average solar flare
200	First deaths from radiation sickness; Van Allen Outer Belt (dose/hr)
500	50% exposed persons will die of radiation sickness
>1000	Major solar flare

Radiation Exposure Criteria

To evaluate properly the biological consequences of exposure to radiation, it is essential to keep in mind the levels of radiation to which man is exposed or may be exposed in different situations. Table IV lists various exposures to provide a basis for evaluating the radiation hazards of space.

Over the past 20 years, it has been the goal of the International Commission on Radiological Protection, the National Committee on Radiation Protection and more recently, the Federal Radiation Council, to develop radiation exposure guides and criteria which would permit people to work in radiation areas with minimal biological damage. In keeping with the increase in the potential sources of man-made radiation as a result of the activities of the atomic energy industry together with other exposures of the population, there has been a continuing major effort to reduce the levels of radiation for the general public and for radiation workers.

The radiation guide recommended for whole body accumulated dose for radiation workers in rem at any age above 18 years is based upon the following:

$$\text{Total accumulated dose} = 5(N-18)$$

where N is the age in years provided no annual dose exceeds 12 rem received in 3 rem increments. On this basis, for example, an individual at age 38 would be allowed to accumulate

$$5(38-18) = 100 \text{ rem}$$

and not more than 5 rem per year thereafter. The 12 rem exposure is allowed only in those cases where the accumulated exposure above the age of 18 has been documented and the work situation justifies this exposure. In an emergency situation, a radiation worker may receive 25 rem provided it does not exceed the recommended accumulated dose for his age.

It has been well established that radiation has definite somatic and genetic effects. The somatic aspects which are manifested as life-shortening, leukemogenic and carcinogenic effects are of importance to individuals exposed to radiation. Genetic injury on the other hand may appear in the offspring as a deleterious mutation and eventually may contribute to an increase in the mutation rate of the population on a statistical basis.

In keeping with current programs and basic philosophy to provide a high degree of radiation protection at reasonable cost without impeding or diminishing the benefits to be gained from the use of radiation or radioactive materials,[27] considerable attention has been given by NASA[28] to the applicability of the current occupational health exposure for radiation workers to the spacecraft occupants. It appears reasonable to use the 5 rem annual exposure level as a goal for vehicle design for routine exposure in space and to allow 25 rem for special missions. For individuals with a known radiation exposure history, it is permissible for the 5 rem dose to be increased to 12 rem provided it does not exceed the total accumulated dose for that individual. In extremely unpredictable or urgent situations, it may be possible during a solar flare that exposure may reach 100 rem or more. Table IV gives an indication of the consequences of such an acute exposure.

It is unreasonable to expect that space exploration and travel will be without a mishap. It is not practical at this time to provide massive and heavy shielding to protect against all possible types of solar bursts and cosmic ray beams. In spite of all our experience and the use of safety devices and precautions, a considerable number of automobile, train, ship, and aircraft accidents still occur that are attributable to adverse weather conditions. It can be expected that just as terrestrial storms cause accidents, so too will space "storms," in the form of intense proton beams resulting from solar flares, cause some radiation overexposures.

If the sound concepts which now apply to occupational radiation exposures are followed, there appears to be no reason why judicious and imaginative application of our present available knowledge on radiation protection and shielding configurations will in any way hamper or interfere with progress in the manned exploration of space.

Summary

In the space environment, man will be exposed to many different types of extremes and stresses. Ionizing radiation constitutes just one of the hazards which must be considered in the design and engineering of vehicles planned for man's exploration and travel in outer space.

The radiation to which man will be exposed includes:

1. Primary and secondary cosmic radiation
2. Protons and electrons present in the inner and outer Van Allen Belts

3. Proton beams from solar flares

Radiation exposure guides have been established for the general public and radiation workers based upon acute and chronic radiobiological effects. The basic concepts and current philosophy regarding radiation protection are applicable also to spacecraft occupants.

For an astronaut circling the earth below the Van Allen Radiation Belts, the radiation levels are minimal and therefore constitute no significant health hazard. Special shielding is not required.

For missions which require flights in or through the Van Allen Radiation Belts, adequate shielding can be provided to keep the radiation dose within prescribed levels. Maximum shielding benefit can be obtained by full use of the inherent absorptive characteristics of the vehicle's fuel, structural design, equipment and supplies to minimize the amount of added special purpose shielding. Reduction in radiation exposure from these zones can be achieved also by using polar escape trajectories.

The most serious ionizing radiation hazard in the space environment is due to solar proton flares. Here again, maximum use can be made of the vehicle design to reduce the extra weight of added shields. Prompt warnings of proton radiation from solar flares can be obtained by optical means and by detection of disturbances of radio communications. No reliable system is available to provide forecasts or predictions longer than a few days to warn of solar eruptions.

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The following three papers are derived from a panel discussion presented at the 1961 Michigan Industrial Medical Association meeting, held in Detroit on March 24. Dr. Price, who discusses the problems of the aging worker from the viewpoint of the private physician, is chairman of the Geriatrics Committee, Michigan State Medical Society.

PROBLEMS OF THE AGING WORKER

as viewed by

I. The Private Physician

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Internist
Detroit, Michigan

It is gratifying to find that industrial physicians recognize the aging worker as having some problems a bit different from those of the younger employee. While there are many areas in which the older worker needs guidance, we as physicians are particularly concerned with those that pertain to his health. The many illnesses which are so prevalent in later life require special consideration, and every effort must be made to prevent disability wherever possible.

Coronary vascular disease with and without decompensation is perhaps the most common with which we have to contend, and is oftentimes the most difficult to evaluate from a disability standpoint. Cerebrovascular disease in all its forms is, of course, the most distressing of all chronic illness and presents a very poor prognosis with respect to continued employment. The various types of chronic pulmonary disease are becoming increasingly common as more men live to the 60 to 65 period of life. It is in this area that toxic substances associated with certain manufacturing processes are thought to be etiologic factors and for which compensation is frequently sought. The many kinds of skeletal disorders which seem to be more common in certain types of work are often difficult to evaluate when disability is claimed to have resulted from injury.

These are just a few of the more common difficulties which older workers may develop, and they pose problems for the industrial physician as well as for the family doctor. In order that the patient receive every consideration, it is important that a close liaison be established between the industrial medical department and the family physician. I am happy to say that a good relationship exists in most areas, for it is very important that each physician recognize the other physician's problem.

In addition to caring for the physical and mental ills of the older worker, as physicians we have an additional responsibility to the aging worker, that of providing him with information pertaining to good health maintenance. Here is an opportunity for practicing preventive medicine, and if enthusiastically presented, I am inclined to think both management and unions would be willing to help.

The worker of 20 to 30 years of age is starting his life's work, trying to find his place in

industry and in the community in which he lives. He is usually well and able bodied. He is more often than not married and raising a family and mainly interested in increasing his income so he can buy a home and enjoy as many as possible of the things that the world has to offer. He is worried only about his immediate future and gives very little thought to the time when he will be 50, 60, or 70 years of age. That time of life is a long way away and he feels he has enough to think about now, so that any thought of the distant future is unnecessary at this time. The only reminder he has is that a certain portion of his earnings is taken out each payday to apply on his Social Security, so that he will have something to fall back on when in the distant future he will retire.

As he grows older he does not think of it as aging. Aging is something which happens to a person in his sixties, seventies, or eighties, not to one in his thirties or forties. He does not realize that this process of aging has been taking place for many years and that the care he gives his body will influence the speed of the aging process. It is this type of health education that might well be presented over the years to the young men and women employed by industry.

The future generation of men and women should be much better informed in matters pertaining to good health than were individuals 25 to 50 years ago. Health education is being stressed in all our schools beginning in the lower grades and extending through college. Efforts are being made to teach the younger generation good habits of eating, rest, and exercise, so that they will have formulated healthful habits of living long before they reach mature adult life. It is hoped they will make these habits a part of their regular routine of living and carry them along through the years, perhaps thereby slowing the speed of the aging process.

As the worker approaches 50 years of age, but more often not until he is 60 years of age, he begins to think about the time he will retire. He wonders about many things. He wonders whether he will have enough money on which to live. Understandably, many workers dread retirement mainly for financial reasons; however, nowadays this is not as great a problem as it was years ago. Loss of income is not the only hazard to be faced. Often a job is a man's chief means of identity in life. If he is no longer a tool maker in a tool and dye company, foreman in a steel plant, manager of a store, or professor of history, who and what is he? Answering this question is sometimes as difficult for the top executive as for the hourly worker.

He wonders also whether he will be well and able to enjoy doing the many things he has been thinking of doing after he retires. He wonders where he will live — in his old home in the city where he has lived for years, or should he move to the country or even to a warmer climate? What will he do with himself when he is no longer a member of the labor force?

Management, and this includes the medical department, should give serious thought to providing some guidance for the worker as he approaches his retirement. This guidance should include regular health appraisal, not only for the executives but also for all employees in at least the last five years before retirement.

"Retirement, on a mass scale, and often at a fixed age, (quoting from a pamphlet on Preparation for Retirement prepared by the National Committee on Aging) is a relatively new phenomenon in American life. It is a by-product of an industrial society with Social Security and industrial pensions. Individuals in our work-centered culture have no common agreement about the desirability of this new period of leisure at the end of life. Many persons anticipate it with pleasure, and prepare for their retirement years with the same interest, ingenuity, and common sense with which they have met other life experiences. Many other persons dread retirement. Hence they avoid thinking about it and planning for it, sometimes with disastrous results.

"Programs of preparation for retirement are based on the assumption that they will aid in the transition and adjustment of those who encounter difficulties.

"Apparently the most important ingredient in each program is the fact the individual is encouraged and aided to look at his retirement in advance so as to come to some kind of terms with it. A preliminary report of the Cornell University study of occupational retirement suggests that *having a plan* is one of the most important elements in successful retirement, even if the plan does not work out according to schedule. The Bell Telephone Company of Pennsylvania found that pensioners who made definite plans before retirement adjusted more satisfactorily than those who made general, sketchy plans or none at all.

"Preparation for retirement and pre-retirement counseling are terms loosely used to describe programs which vary widely in content and method. There is a vast difference between the single interview to explain pension and Social Security benefits to a retiring worker or the placing of printed materials about retirement on a reading rack for casual use by employees, and the programs consisting of a series of carefully planned individual or group discus-

sions under skilled and trained leadership, with background materials prepared especially for persons planning their retirement years.

"Preparation for retirement is one of the fast growing employee relations services in American industry.

"It should be noted, however, that not all employers believe that preparing workers for retirement is their responsibility.

"The personnel director of a large department store (without a pension plan) explains that his company's policy is to keep employees from thinking about retirement. He believes that if they face it realistically, they may become useless as workers. An executive of an industrial concern states that the only preparation for retirement a company needs is an iron-clad system of compulsory retirement at a fixed age. He believes that if the individual knows he will be obliged to retire at a specified time, he himself will do all the preparation necessary.

"On the other hand, W. L. Johnson, Vice-President of Bell & Howell Co. (3,500 employees), manufacturers of photographic equipment, takes the view that whether an employer has a flexible or compulsory retirement program, the success of the program depends on the educational preparation for retirement. Industry, he points out, is spending millions of dollars helping younger employees prepare for a successful career, and industry, he suggests, owes its older employees just as much in the way of preparation for the retirement years.

"In commenting on the retirement preparation program of Carson Pirie Scott & Co. (4,500 employees), a Chicago department store, Martha Douglas, Director of Counseling and Employee Activities, stresses the effect of the attitude of older company employees on younger workers. She says: 'For the effect on worker morale alone — that intangible quality which can make or break a business — a successful retirement preparation program pays dividends.' Furthermore, she suggests, the older worker who 'retires with plans for a hopeful future . . . facing the later years with confidence, builds invaluable customer goodwill for the company. Since good will is essential for business success, we believe the investment in a retirement program that contributes so much to general morale is a sound business venture.'

"Between these opposing philosophies are many shades of opinion. Typical of one position is the attitude of a director of industrial relations who believes that while 'there are great possibilities in counseling of our people in middle and late years . . . there should be no sudden drive or propaganda on problems of retirement.' Another executive of a manufacturing concern believes that pre-retirement counseling should be limited to explaining the pension plan — 'anything beyond that is paternalistic.'

"Robert L. B. Roessle, a spokesman of the Employee Relations Department of the Standard Oil Co., (New Jersey), (153,000), says: 'The Standard Oil Company believes its liberal employee pension plans will be defeated if the individual alumnus is going to have an unhappy frustrated old age. There is a definite limit to corporate paternalism. Yet we feel that the company should help our people to approach retirement aware of the adjustment problems they may face. They may then plan for their retirement in advance.'

"Mr. Roessle, who has worked for 10 years on pre-retirement counseling programs with the company, says he is 'constantly impressed by the vast differences which occur in the individual and the particular type of organization or industry. I am convinced that there are no right and wrong answers which can be readily transferred from one situation to another.' "

Retirement is one of the problems of the aging worker. As medical men we are mainly interested, to be sure, in the various health aspects of the older worker, but the more we become interested in the over-all picture the more we shall realize that good health is not the only difficulty with which the aging worker has to contend and that oftentimes the other problems have a striking influence upon his health. Is it not logical, then, that we should use our influence to provide some comprehensive pre-retirement training for the aging worker?

PROBLEMS OF THE AGING WORKER

as viewed by

II. The Industrial Engineer

• L. J. LANGTON
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When we consider the "problems of the aging worker"; we must first define aging worker:

An unemployed worker age 45: One who looks through the want ads and sees continual restrictions on age, such as, "young man under age 35," "under age 40," etc. Job availability is rather slim.

An employed worker with 20 years seniority at age 50: One who doesn't like his job today; in his younger years he took on a heavier job because of the higher rate of pay and today he finds it monotonous and fatiguing.

The physically handicapped worker at the age of 40: Unless he has several skills and training there are few jobs available for him.

The unskilled laborer at age 55 who starts to slow up: What is available for him, particularly if he is interested in stepping down to a lower rate, lesser paced job?

In each instance, there are particular circumstances that contribute to and identify age as a problem; some of these require the assistance of the medical man, others require the assistance of management, union, and the workers themselves.

The Industrial Engineer

It may be well to summarize briefly the industrial engineer's position and function. The industrial engineer is concerned with the economic utilization of man, materials, and equipment, economic utilization commensurate with the health and safety of the worker, quality and consumer acceptance of the materials, and the capacity and cost of equipment.

His function is to design work methods that will yield minimal labor cost per unit by the average employee working at a normal pace, and to give consideration to the health and safety hazards associated with the performance of such work. Under such a determination neither age nor physical limitations are a factor.

Since our attention is to the worker, I shall not expand on the materials and equipment aspect of industrial engineering, except as an aid to enlighten the problems of the aging worker. One of the primary functions of industrial engineering is work standards — the establishment of time values for the performance of work. Techniques used are sound and proved; management and worker have accepted work standards with but little exception.

Those problems associated with physical handicaps or limitations must be first handled by the industrial physician; the industrial engineer through proper job analysis and evaluations can aid in the assignment and utilization of the physically limited or aged worker.

The Older Worker

When we consider the present and future manpower needs of the country and the availability of workers by age group, we note in 1945 we had 28.6 million workers between the ages of 46 and 64, by 1955 the total was 33.4

Presented at the annual meeting of the Michigan Industrial Medical Association, March 24, 1961.

million, and by 1965 the total will climb to 39 million.[1]

What are some of the conditions that we associate with the worker and recognize as part of the process of aging? Under normal conditions the sense organs begin to deteriorate in middle age, muscles as force decline very slowly to age 60, but stamina, the ability to undertake sustained muscle activity, does decline appreciably. Muscle movements tend to become intermittent or jerky, rather than smooth and rhythmic.

While aging adds to experience, experience compounding slows up the ability for decision making. Aging affects the short term memory process, and as people get older they are less able to think about more than one thing at a time.

Worker productivity per man hour shows relatively little variation in average performance among age groups, but considerable variation among individuals within the same age group does exist. This particular fact is evident to the industrial engineer. Among factory workers, performance tends to be highest for the 25 to 34 year age group. The average performance is generally demonstrated by those in the 35 to 40 age group. Workers in the age group of 45 and above show some slight decrease in performance, proportionate to the physical demands of the work involved.[2]

Among the older workers we find strong attributes for a good work force: better attendance record, safer workers, less turn-over; they are less demanding, more loyal and more satisfied; and workmanship is of better quality and accuracy. Generally, they require less supervision because of their greater experience and knowledge in handling assignments.

Thus age is not necessarily a problem for the employed physically qualified worker — the problem is whether he retains his present physical condition and employment. With increasing age he becomes more susceptible to various chronic conditions which in some instances may restrict his ability to continue in his present occupation. The U. S. National Health Survey reports as follows:[3]

Percentage of workers by age group with some chronic condition:

Group — age	45-54	52.3%
	55-64	58.7%
	65-74	65.0%
All Ages	45+	56.1%

The workers' employment today is subjected to many new factors, because of the changing complexity of industry in terms of marketing, methods of manufacturing, and geographic relocation. Many manufactured goods available today were nonexistent before World War II, and many products have changed their character, due to the technical advancements in the use of synthetics for industrial and consumer goods.

As a point of reference on geographic relocation, here are comments from the National Conference on Automation:[4]

> In connection with its decentralization and modernization program one of the major automobile manufacturers located its new foundry, engine, and stamping plants in Cleveland and Buffalo. Keeping in mind that most of the ores that they will be using in the years to come will come from Labrador and not from Minnesota, that decision perhaps makes sense. The workers that went into the Buffalo and Cleveland plants are new, they are young; they do not have old habit patterns that must be changed. On the other hand, the workers in the Detroit area and in some of the other older automotive centers, where the machinery is old, have the tendency to want to stay in their communities rather than transfer with the jobs. There is a danger that these workers might become obsolete along with the factories in the older centers.

Methods of manufacturing have undergone considerable changes which are attributed to technology and automation. Automation has substituted tension and mental effort for muscular fatigue, and also has created a demand for new skills and knowledge. Physical effort contributed by the worker when measured against the degree of automation of his work clearly shows a declining curve. That is, the physical effort exerted by the worker will be highest in the lower levels of mechanization and will decline as a level of mechanical control is reached to a point where no physical effort is required under a completely automated control system.[5]

As a result of new materials, new methods, and new modern industrial installations, the employee of the future will work in an environment which was restricted to a limited few in the past. The era when hard back-breaking work ruins the health and threatens the safety of the worker is quickly coming to a close. Already the results of automation have changed some thinking on the subject of industrial and occupational safety. Despite the too high level of accidents, accident rates are far below what they were 30 years ago. The opportunity to reduce occupational hazards to a minimum base, affected only by acts of God, is within reach.[6]

Thus new materials, methods, and facilities are and will continue to improve the lot of the aging worker by reducing the effort and hazards of industrial work.

To give further visibility to the problem of the aging worker, it would be well to review the conclusions and recommendations made by the Retirement Council Inc., based on a survey of practices and policies of 163 manufacturing companies:[7]

Conclusions Reached: Vintage values of workers over 50 far exceed the drawbacks of physical deterioration. Older workers are hampered not so much by the effects of age as by restrictive attitudes and practices of management and unions.

Recommendations to Management: Counsel workers aproaching maturity. Institute programs for all levels of management in regard to the attitude and thinking of the older workers about their company, their superiors, and their jobs. Train supervisors how better to deal with older workers.

Older Workers: Continue to show value through quality of work, attendance, and attitude. Recognize physical limitations instead of showing resistance and frustration. Use skill and experience when opportunities come to retrain for less arduous tasks.

Labor Unions: Recognize the demands of an older working force when setting up seniority plans, and interpret rules in order to give older workers proper job placement. Train officers and committee members to help plant management in the full use of the older workers' skills.

If you were to ask representatives of management, the older worker, and the labor union what they are doing along the lines of these recommendations they would all reply, "We are doing some of these things." But the problem is whether these recommendations will be implemented quickly enough to meet the accelerated rate of longevity and technology.

Selective Placement

In the meantime, there is one approach to the problem of the aging worker that can be carried out jointly by the industrial physician and the industrial engineer. Selective placement is the scientific job placement of older workers based on objective and detailed analysis of the physical and environmental demands of each job, and the physical capacities of the worker.

Presently such an approach is underway in a few manufacturing companies, and others are in the process of evaluating such a program. But it will be a slow process requiring a change in the economic philosophy and attitude of the worker, the union, and management. Based on government forecasts of the standard of living and the available work force, by 1975 it will be necessary to utilize fully all of our older workers, including those physically limited; this can be accomplished through selective placement.

The thoughts and opinions contained herein are those of the author or specific reference and they do not represent those of Chrysler Management or policies of the Chrysler Corporation.

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New Publications by the Center for Aging Research

Three annual publications of the Center for Aging Research, Division of General Medical Sciences, National Institutes of Health, are now available for distribution.

Research Highlights in Aging presents a review of a selected number of scientific papers on research in aging carried out or supported by the National Institutes of Health. They range from fundamental studies in the biology of aging to studies concerned with the physical, psychological, and social problems of aging people. In addition, the brochure includes reviews of new literature, meetings of considerable importance, programs of the five major multidisciplinary centers for aging research, and training programs.

Activities of the National Institutes of Health in the Field of Gerontology lists all grants for aging research active on January 31, 1961, arranged in two categories — those primarily related to aging and those secondarily related to aging.

The third document, *Research Programs in Aging,* prepared originally as background material for submission at Congressional hearings on appropriations, covers in narrative form all intramural and extramural studies supported or conducted by the National Institutes of Health in the field of gerontology.

All documents are available free upon request to the Information Officer, Center for Aging Research, National Institutes of Health, Bethesda 14, Md.

PROBLEMS OF THE AGING WORKER

as viewed by

III. The Disability Examiner

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As we look over the life span of the industrial worker, we recognize readily three parts or phases.[1] The first is the preparation and training; the second, productive years of employment and, third, retirement.

Retirement is rapidly gaining ground on the other two in terms of importance and scope. This naturally produces problems in many areas.

Happiness and contentment in the third phase of the life cycle rests on several pillars. The individual must be secure economically, and he should be in the best possible health. He should be educated somewhere along the latter years in the matter of retirement and he should have some definite plans. He should live in a community that he likes, and not in a new area for which he has developed a temporary liking, particularly if it means cutting himself off from friends and relatives and hoping to find new friends at a time in life when this is becoming increasingly difficult. He should, by all means, keep busy and have a sense of being wanted. Needless to say, he should be fully adjusted to his situation or station in society. All of this requires the basic desire to live in a happy environment; and to avoid loneliness, feelings of not being wanted, quarrelsomeness, anger, and all of those things which tend to be negative. Certainly here the emotional life is very important and the industrial physician is in a good position to play a large part in this respect. Religion and faith are of great importance.

Presented at the annual meeting of the Michigan Industrial Medical Association, March 24, 1961.

Disability Retirement

In the disability phase of retirement or possible retirement, the disability examiner plays a significant role. It is important for the profession, and those associated in this endeavor, that they understand the basic philosophy of those who are engaged in this field. Needless to say, disability evaluation is not an exact science. There are many variables and there may be areas of honest differences of opinion. During periods of economic stress, the number of applications for medical retirement under various disability provisions will rise sharply. In these times, there may be areas of disagreement and the gray areas of partial disability will become more evident.

With the advent of the Workman's Compensation Act, the injured worker is provided medical aid under law, and insurance of various types cushions the losses due to injury and disease. However, prolonged periods of disability challenge his economic, social and personal welfare and his survival.

To meet this problem before retirement, there have appeared in industry and labor contracts disability provisions designed to aid the individual who has made a reasonable contribution to society in terms of production and service. This type of disability compensation is available on a personal basis through various insurance

companies. In more recent years, special legislation has been passed, such as amendments to the Social Security Acts of 1950, 1954, 1956, 1958, and 1960. Grants-in-aid plans that may be interwoven with state plans vary considerably and are widening in scope.

As society has broadened its conscience and responsibility toward its human components, the problem of evaluating disability has become more accentuated. As physicians, we are reluctant to become involved in this particular phase with its numerous ramifications. Nevertheless, in the certification of the individual as disabled, the physician's role is most important, for without his study and interpretation of a case, proper analysis would be impossible. Needless to say, this is a great responsibility and a headache. The physician is very much aware that for every person granted a disability benefit, a still greater contribution by the remaining working forces of the nation will be necessary. The basic principle that people are better off working than rusting out needs no emphasis.

In any consideration of a total and permanent disability problem, there are certain fundamental principles and concepts which should attract our attention.

When called upon to evaluate whether an individual is totally and permanently disabled, it is absolutely necessary that we understand clearly what the contracting parties had in mind — whether it be a company union contract, a private insurance contract or whether it is a social security benefit or a benefit set up by the State Welfare Commission. The intent of the contract or the intent of the law and the procedures and the rules of enforcement may be rather complex. In both the company union contracts and the social security plan, the person's remaining assets (in the sense of net worth) do not play any part. The pertinent questions concern the ability of the individual to be gainfully employed and whether he can meet other qualifications, such as length of employment or contributions to the social security system. On the other hand, many state welfare aid plans do not take into consideration the patient's past contributions in terms of production and service, but pay more attention to the individual's remaining assets.

Total and Permanent Disability

The present industrial point of view of total and permanent disability is that an individual has been disabled by bodily disease or injury so as to prevent him from engaging in a regular occupation or employment for remuneration or profit; and such impairment will be permanent and continuous during the remainder of his life.

Many contracts deny benefits if the disability is related to chronic alcoholism or narcotic addiction, to injury sustained while engaging in a felonious assault or self-inflicted injury, or injury suffered while in the armed forces of any country.

The designation, total and permanent disability, needs clarification, particularly if it is taken to imply that both factors must be evident with absolute certainty.

Strictly speaking, such a person would be deceased or moribund. Almost every person, no matter how chronically ill, has remaining capacity for work of some sort. A person who is paralyzed from the waist down may write a successful book or conduct a business by telephone. Persons with severe physical handicaps may go to high places in government or industry. As we all know, the late President Roosevelt had a very severe physical handicap in the residuals of his poliomyelitis and in spite of this, he became a world figure. However, in such cases the assistance of another person is often necessary to meet the many other requirements of daily living and work has to be brought to the person rather than he go to work. Ability to do an occasional odd job can hardly be disqualifying. In those instances where a person is so impaired as to require that work be brought to him, he may not be disqualified under the terms of a company union contract but under the terms of the Social Security Administration, he could be disqualified because of the earnings provision.

The modern industrial concept behind many company union plans is that utter physical and mental helplessness as a result of injury or disease is not a requirement of total and permanent disability.

Also, the term "permanent" surely cannot be interpreted in its extreme sense of meaning absolutely predictable, everlasting, unchangeable, or unending disability. It is used relatively in contradistinction to temporary or transient disability. This is apparent from the usual requirement that evidence of continuity of the disability may be required at suitable intervals. This provision recognizes the fallibility of human predictions. The problem of certainty of prediction is inherent in the very problem. Obviously, slight chance of improvement cannot destroy permanency. The mere possibility of permanence cannot be enough for the finding of permanency. Permanence refers to an impairment in which the concept of cure cannot be applied. Certainly, any condition which medical science thinks is not likely to respond to any known treatment may be considered as permanent.

Futhermore, any condition likely to remain static, or to become worse unless certain thera-

peutic measures are carried out, may be deemed to be permanent if treatment is unavailable or deemed unadvisable. Permanence does not rule out the possibility of vocational rehabilitation, or even recovery from the impairment. Every physician knows of cases which respond favorably to treatment after an unfavorable prognosis or after a disability condition becomes arrested.

New advances in medical treatment may change the picture of a disabling disease. However, in those cases in which corrective treatment has been tried and has failed and the individual has submitted to further treatment with failure, there is some question whether benefits should be denied. When the individual is resistant or has lost faith because of past failures or when there is a real presence of further jeopardy, there is raised a point of reason and justice. The American philosophy is against the use of force or undue pressure. Here there may be some invasion of a person's constitutional rights.

However, those providing the benefits do not intend the disabled to remain so through choice or unwillingness to submit to cure.

Impairment

Impairment means the presence of a disease process — physical or mental or both — or of an anatomical abnormality.

Remaining capacity for activity is important. The great majority of people have more abilities than disabilities. These include the ability or capacity to carry on usual work or gainful employment, to get to and from work under reasonable climatic conditions, to take care of personal needs, to get along with fellow workers with minimum tensions.

Of great importance is the necessity to evaluate the effect of the impairment of function. The relationship of pathology to disturbed physiology is basic. An electrocardiographic diagnosis without reference to function creates hardships, anxieties, frustrations, loss of hope, and unwarranted removal of the individual from an effective, happy, productive life.

Total disability refers to incapacity to engage in any useful work. The time factor does not enter into the definition of totality. A person just operated on for a gastric ulcer is obviously totally disabled. However, medical experience shows that he can be expected back on the job in four weeks, so there is no permanence. An individual whose leg was amputated 25 years ago and who has had a job for the past 25 years has a permanent impairment, but obviously he is not totally disabled.

Regular occupation means one commonly accepted as such and one not created especially for the patient. Regularity or reasonable regularity of performance goes with this. Of what use is a toolmaker, a regular occupation, when the toolmaker's impairment prevents him from working more than one day each week?

Gainfully employed or employment for remuneration or profit means that the individual can be productive for his employer and for himself, and that the job is not in the nature of a sinecure or a unique job.

The Private Physician and the Disability Examiner

The role of the family doctor is considerable in cases brought before the impartial medical examiner. He first records the sequential medical history of the case. Thus, a record is made which may shed light on the impairment. The local physician has sociological data not readily available to others. His opinions are valued and respected. He has the responsibility of caring for the person medically for the future. The family physician is happiest when his patient is rehabilitated or returned to an effective economic pursuit. The family physician becomes concerned in the family problems brought about by the changes of retirement.

On the other hand, many family physicians are not experienced in the physical, mental and temperamental requirements of industrial occupations.

When the medical impairment is severe, little difficulty arises; but when the disability produced is borderline, and there may be numerous instances of this, special experience may be desirable.

There are some understandable yieldings on the part of the family physician to the desires of the patient. Independent examiners go a long way towards eliminating this problem. The attitude of the Social Security Administration on this point is noteworthy. The Social Security Administration makes the determination of inability to participate in gainful employment on the basis of medical reports submitted to their examiners. They may purchase special medical examinations. They do not expect, nor do they want, a private physician to take the responsibility for this determination. As a matter of fact, I am sure that you have noted that the Social Security Administration has tended away from the designation of total and permanent disability and uses that of gainful employment.

The opportunity for further examination of those rejected should also include the review of any additional data submitted. The records of the plant physician and personnel here have value. Time lost because of illness, nature of

the illness, regrading of the remaining capacities, reassignments, may contribute much to the evaluation. As a matter of fact, the real test of disability is individual's inability to do a job. Several regradings to lower levels are indications that productive life is coming to an end. Social factors, such as age, racial origin, training, language, education, marital situations, home surroundings, may have variable medical significance. These may vary with each case.

Needless to say, there are certain reactionary factors which make disability evaluations difficult, ambiguous, and variable.[3] These involve human equations and opinions which are difficult to regulate and standardize and correlate.

Here we have the loss of will to work. Needless to say, this is important. The reasons for this may be very complex. They may be due to the presenile aging process, to frustrations of life, depressions, the feeling of not being wanted, the feeling of being at the end of the road, as well as to adverse social relations, difficult labor situations, and unfavorable labor climate. Often these factors are minimal, but at times they are important, and almost determining factors.

The role of the examining physician may vary considerably. He may simply provide facts on which a board can act, or, on the other hand, he may be a quasimember of the determining board. In certain instances, the retirement boards may rely completely on the judgment of the physician, and in other instances a determination will be made by a group in which the physician plays a major role. This is particularly true when special factors are involved. In the matter of keeping records, there can be no doubt that rating systems are of great value and are to be encouraged in every respect. Certainly, follow-up and future study are greatly facilitated by this procedure. However, retirement boards can function best when clear cut determinations and recommendations are made.

Much of what has been said, up to now, is essentially in particular reference to total and permanent disability evaluation from an industrial point of view. One should recognize that there is a diversity of requirements and one should be familiar with his state's definition of total and permanent disability. In the State of Michigan, special public acts provide that assistance may be given to any needy individual who is permanently and totally disabled. This requires a definition of total and permanent disability by the Social Welfare Commission. In this definition it is stated that a person will be considered to be permanently and totally disabled if it has been established by medical and other evidence that he has a physical or mental impairment or both, which cannot be corrected within the foreseeable future and, too, by reason of such impairment he is unable without the help of another person to carry on the minimum activities essential to daily living as determined by the State Social Welfare Commission. Attention is directed to the fact that there are two provisions: one relates to the permanent nature of the impairment and the second provision establishes the basis for determining whether the resulting disability is total relative to its effect on the activities of the individual. This totality is measured by the needs for the help of another person to carry on the minimum activities essential to daily living. This particular phase of evaluation is based upon a combination of medical and social information.

In reference to this, there has been some general loosening up from an administrative point of view regarding the need or the closeness of the person assisting in the daily activities of the individual.

Summary

Various disability retirement plans and the larger number of older workers undoubtedly will require an increasing number of clinical examinations for the evaluation of medical impairments. These reports must be factual. They must be relatively recent, and they must be definite and clear in order that the various programs can be satisfactorily administered. There may be variations from one plan to another and a pension secured under one may not be a guarantee of a pension under another.

There is little question at all that the core of the problem is the effect of the impairment on the individual's functional capacity. There, too, may be in certain plans, some factors entering into the acceptance or rejection of the pension application that are not strictly medical. Much judgment, both medical and administrative, will be necessary in the proper evaluation of this group of people.[4] The role of pain, the proper evaluation of multiple minor impairments and the recognition that disease and impairment and disability are not static must be taken into consideration. The patient's motivation and adaptability deserve special attention. Regrettably, rehabilitation in this group of individuals has been most discouraging.

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Pathology Elicited Through Routine Chest Roentgenograms

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For many years, the chest roentgenogram has been recognized and accepted as a very efficient and relatively safe procedure for the detection of disease. These films supplement and confirm classical, clinical procedures.

At Cadillac Motor Car Division, all films are divided into 10 diagnostic fields according to the portion of the body surveyed. In each of these 10 fields, pathological conditions are enumerated along with the specific location of the pathological condition when such is essential. The 10 fields are as follows:

1. Sinuses, Mastoids, Bones of Face, Mandible
2. Skull
3. Spine
4. Upper Extremity
5. Lower Extremity
6. Thoracic Wall, Mediastinum, Soft tissues of Neck, Cardiovascular System
7. Lungs and Pleura, other than Tuberculosis
8. Intrathoracic Tuberculosis
9. Gastrointestinal Tract
10. Genitourinary Tract

A tally sheet for each field is maintained by the x-ray technician.

This report covers only the findings detected by chest roentgenograms. Consequently, only field 6 relating to the thoracic wall, mediastinum, soft tissues of the neck and cardiovascular area, field 7 relating to the lungs and pleura other than tuberculosis, and field 8 relating to intrathoracic tuberculosis are included in the scope of this study.

The findings that are presented were detected during the period July 1, 1954, to March 1, 1960. This was a period of relatively stable employment with the employee population averaging 10,672.

It is important to point out that the tabulation of the pathological condition was recorded from the initial roentgenogram leading to the establishment of diagnosis. No additional tabulation was made when the condition was merely demonstrated on a repeat film.

During this period 5,443 14 by 17 chest roentgenograms and 22,682 70 mm photoroentgenograms were performed, for a total of 28,125. The 70 mm photoroentgenograms were generally performed on a routine basis. Many 14 by 17 roentgenograms were taken as a result of the initial detection of pathology with the 70 mm. Many more 14 by 17 roentgenograms were taken when clinical findings indicated a greater likelihood of the presence of pathology prior to the roentgenographic study.

Table I below shows the total number of pathological findings according to the method of detection as well as the incidence for each diagnostic field.

TABLE I.
PATHOLOGY AS RELATED TO NUMBER OF ROENTGENOGRAMS AND METHOD

	No. of X-rays	Pathology #	Pathology %	Field VI #	Field VI %	Field VII #	Field VII %	Field VIII #	Field VIII %
14 x 17	5,443	681	12.5	47	27.5	134	26.2	72	28.7
70 mm	22,682	253	1.1	124	72.5	378	73.8	179	71.3
TOTAL	28,125	934	3.3	171	100.0	512	100.0	251	100.0

The first and most basic finding in our research was that during the period of study, 934 individual cases with pathology in the chest area were detected. Table II shows a breakdown of these cases according to diagnostic fields.

Tables III, IV, and V show a further break-

TABLE II.
NUMBER OF CASES WITH PATHOLOGY

	Field	Cases Number	Cases Percent
VI.	Thoracic Wall, Mediastinum, Soft Tissues of the Neck, Cardiovascular System	171	18.3
VII.	Lungs and Pleura	512	54.0
VIII.	Intrathoracic Tuberculosis	251	26.9
	TOTAL	934	100.0

Presented at the General Motors Medical Conference, Rochester, New York, April 25, 1960.

TABLE III.
PATHOLOGICAL FINDINGS IN FIELD 6

Pathology	Cases Number	Percent
Thoracic Wall	86	50.3
Mediastinum	3	1.8
Cardiac Enlargement	35	20.5
Rheumatic Heart	3	1.8
Aorta Changes	35	20.5
Other	9	5.3
TOTAL	171	100.0

down of each of these diagnostic fields according to the pathological findings disclosed. In field 6, evidence of trauma, such as fractured ribs, new or old, accounts for the major portion of the 86 or 50.3% of the total pathological findings listed as thoracic wall findings. Three or 1.8% pathological findings of the mediastinum were substernal thyroid cases. Thirty-five or 20.5% were cases of generalized cardiac enlargement, indicating relatively severe heart disease.

Three or 1.8% cases revealed evidence of rheumatic heart disease, the characteristic changes of mitral stenosis being noted. Thirty-five or 20.5% were cases showing enlarged tortuous aortas, a manifestation of arteriosclerotic disease.

TABLE IV.
PATHOLOGICAL FINDINGS IN FIELD 7

Pathology	Cases Number	Percent
Pneumothorax	5	1.0
Pulmonary Emphysema	23	4.5
Pneumoconiosis	17	2.3
Fibrotic Changes	341	66.6
Primary Neoplasm	10	2.0
Boeck Sarcoid	3	0.6
Other	113	22.0
TOTAL	512	100.0

In this field of diseases of the lungs and pleura other than intrathoracic tuberculosis, numerous conditions of significance were detected. We found five or 1.0% cases of spontaneous pneumothorax; 23 or 4.5% cases of pulmonary emphysema; 17 or 2.3% cases of pneumoconiosis, most of these being suspected rather than complete diagnoses; 341 or 66.6% cases of nonspecific pulmonary fibrosis; 10 or 2.0% primary neoplasm cases (no secondary neoplasms being detected by this procedure); and three or 0.6% Boeck Sarcoid cases.

The pathological finding of nonspecific pulmonary fibrosis is one that we found to be of great interest. This condition is one that may result from numerous etiological agents. It may exist prior to or be part of the development of other diseases.

A total of 37 cases of active tuberculosis were detected during the period of study. At the time of detection, seven were minimal; 25 were moderately advanced and five were advanced cases. It can be assumed that the major proportion of these active cases were severe public health menaces prior to discovery.

The 1959 edition of the Tuberculosis Chart Series of The U. S. Department of Health, Education, and Welfare, Public Health Service, indicates that tuberculosis deaths are declining twice as fast as newly-reported cases. With the sharper decline in deaths and the slower decline in new reported cases, there has been a gradual improvement in case fatality rates during the past 10 years. Tuberculosis facts and figures in Michigan indicate that more than 5,000 new tuberculosis cases are reported each year. A tuberculosis case load of 16,697 was reported on June 30, 1959, as being under health department supervision. There were 5,417 people with active tuberculosis requiring treatment and 11,280 people with inactive tuberculosis requiring periodic check-ups. Tuberculosis is costly. It is just as infectious today, just as destructive, just as deadly if undiscovered or untreated as it ever was.

With a factory population averaging 10,672 employees and with our present Medical Department staff and facilities, plus the necessity of avoiding excessive losses in production time, it is neither possible nor essential to periodically examine all employees. The selection for periodic medical examinations of employees who by experience prove to have more numerous and possibly greater medical problems is much more rewarding. Consequently, for each diagnostic field, an analysis of pathological findings located in each of the selected groups is made, thus indicating to some degree the efficiency of this method of case finding.

The next three tables show a breakdown for each diagnostic field, as related to the reasons for taking chest roentgenograms.

Table VI shows that the highest incidence of finding occurred when the chest roentgenogram is performed on an employee returning to work after illness. This method revealed 45 cases or

TABLE V.
PATHOLOGICAL FINDINGS IN FIELD 8

Pathology		Cases Number	Percent
Minimal		186	74.2
Active	7		
Arrested	0		
Inactive	179		
Moderately Advanced		40	15.8
Active	25		
Arrested	6		
Inactive	9		
Advanced		9	3.6
Active	5		
Arrested	2		
Inactive	2		
Other		16	6.4
TOTAL		251	100.0

TABLE VI.
REASONS FOR TAKING CHEST ROENTGENOGRAMS IN FIELD 6

Reason	Cases Number	Percent
Request of public health	0	0
Request of private physician	2	1.2
Pre-employment examination	30	17.5
Periodic physical examination	13	7.6
Return to work following illness	45	26.3
Special hazard exam. — drivers, etc.	6	3.5
Known disease requiring follow-up	6	3.5
Department routine exam. (usually 70 mm)	23	13.5
Clinic visit in which x-ray was indicated	44	25.7
Supervisory	2	1.2
TOTAL	171	100.0

26.3% of total findings in this field. There was also a high incidence of finding, 25.7%, as a result of clinic visits in which the taking of chest roentgenograms was indicated.

In Table VII we again see a high incidence of pathological findings when chest roentgenograms are performed on employees returning to work after illness, revealing 101 cases or 19.7% of total. The highest incidence in this field is when a roentgenogram is performed as a result of a clinic visit in which the procedure was indicated, revealing 129 cases or 25.2% of total.

TABLE VII.
REASONS FOR TAKING CHEST ROENTGENOGRAMS IN FIELD 7

Reason	Cases Number	Percent
Request of public health	2	.4
Request of private physician	10	1.9
Pre-employment examination	76	14.8
Periodic physical examination	35	6.9
Return to work following illness	101	19.7
Special hazard exam. — drivers, etc.	75	14.7
Known diseases requiring follow-up	15	2.9
Department routine (usually 70 mm)	69	13.5
Clinic visit in which x-ray was indicated	129	25.2
Supervisory	0	0
TOTAL	512	100.0

From Table VIII, we may conclude that a significant incidence of roentgenographic findings related to tuberculosis exists in almost all categories of reasons for examination. Seventy cases or 27.9% of total showed evidence of tuberculosis on pre-employment examination. Though not shown on this table, seven cases of active tuberculosis were detected as a result of a clinic visit in which an x-ray was indicated. Seven cases of active tuberculosis were also detected as a result of follow-up study on employees with previous known disease, thus indicating the importance of continuing periodic checks on cases of arrested tuberculosis. Five cases of active tuberculosis were detected in employees returning to work following illness, the diagnosis prior

TABLE VIII.
REASONS FOR TAKING CHEST ROENTGENOGRAMS IN FIELD 8

Reason	Cases Number	Percent
Request of public health	1	.4
Request of private physician	8	3.2
Pre-employment examinations	70	27.9
Periodic physical examinations	20	7.9
Return to work following illness	29	11.6
Special hazard exam. — drivers, etc.	21	8.4
Known disease requiring follow-up	14	5.6
Department routine exam. (usually 70 mm)	44	17.5
Clinic visit in which x-ray was indicated	44	17.5
Supervisory	0	0
TOTAL	251	100.0

to this generally being pneumonia, bronchitis or something of that nature.

Table IX shows the relationship of age to pathology. In field 6 there appears to be no significant finding by age distribution. In field 7 there is a preponderance of cases in the middle decades of life. Note that there are 122 cases or 23.9% in the 30 to 39 age group; 130 cases or 25.2% in the 40 to 49 age group. In field 8, there is also a preponderance of cases in the middle decades of life. The highest incidence of 75 cases or 29.9% is in the 30 to 39 age group; 63 cases or 25.0% in the 40 to 49 age group. Though not correlated with the age distribution of our factory population, it is of interest to note that this distribution does roughly correspond with both national and Michigan experience for tuberculosis.

The General Motors 1959 Annual Report indicates there was an average of 557,218 men and women employed by the corporation throughout the world. There exists within the corporation medical facilities and staff with the ability to accumulate a vast amount of information with greater accuracy than can probably be accumulated by any other group.

This study of pathological findings at Cadillac Motor Car Division indicates that the incidence is significant and warrants the continued use of the chest roentgenogram. A tremendous amount of information is available for analysis which may be of value in improving our technique for the early detection of disease.

TABLE IX.
RELATION OF AGE TO PATHOLOGY

Age Group	Field 6 #	Field 6 %	Field 7 #	Field 7 %	Field 8 #	Field 8 %
Teens	1	.6	9	1.8	7	2.8
20-29	27	15.7	96	18.8	56	22.3
30-39	44	24.0	122	23.9	75	29.9
40-49	29	17.0	130	25.2	83	25.0
50-59	31	18.1	91	17.8	30	12.0
60-69	42	24.6	64	12.5	20	8.0
TOTAL	171	100.0	512	100.0	251	100.0

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A STUDY OF CARBON TETRACHLORIDE

III. Tissue Enzyme Response to Carbon Tetrachloride Inhalation

Several papers[1,2,3] have reported changes in the level of serum and tissue enzyme activities following exposure to or ingestion of CCl_4. In general, these reports have been limited to a study of serum or liver enzyme activities since it is known that the liver is a primary site of CCl_4 damage. Previous reports from this laboratory[3,4] have demonstrated marked increases in the level of serum glutamic-oxaloacetic transaminase (GOT), esterase, and xanthine oxidase 24 hours after exposure of rats to 6000 ppm of CCl_4 for four hours. A significant increase in serum GOT was demonstrated following exposure to as little as 250 ppm of CCl_4 vapor for four hours. Liver xanthine oxidase and esterase activities were markedly depressed after exposure to 6000 ppm of CCl_4 vapor while liver GOT was slightly elevated. Data recently obtained by Brody[5] implicate the central nervous system and the adrenals in the toxic response to CCl_4. Fat mobilization has been reported many times[5,6] and is an early manifestation of the action of CCl_4.

The present report is a study of the effect of CCl_4 exposure on enzyme activities of brain, adrenal, and fat, and is an attempt to correlate these changes with the enzymatic response noted in serum and liver. The enzyme activities studied have been extended to include glutamic-oxaloacetic transaminase (GOT), glutamic-pyruvic transaminase (GPT), lactic dehydrogenase (LDH), malic dehydrogenase (MDH), and esterase.

Experimental Procedures

Male rats of the Sprague-Dawley strain (Holtzman), 250-300 grams in weight were used in all studies. Animals were exposed for six hours to 6000 ppm of CCl_4 vapor in a stainless steel dynamic exposure chamber as previously described.[4] Since previous studies indicated that maximum changes in enzyme levels in serum and liver occur approximately 24 hours after exposure, five rats were sacrificed at this time. Additional rats were sacrificed 48 hours after exposure to determine the continuing trend of enzyme activity. Animals were stunned and blood collected by decapitation. The tissues were removed immediately, rinsed, blotted, and weighed. Fat was removed from the lumbar area of the rat. The various tissues were homogenized in 0.1 M phosphate buffer and kept frozen until analyzed. Analysis of fresh and frozen samples indicated no change in activity during the period in which these homogenates were kept frozen. Four male rats of the same weight were used to determine normal enzyme levels in the various tissues.

Esterase activity was determined by the Gomori colorimetric technique[7]; glutamic-oxaloacetic transaminase (GOT), by the procedure of Steinberg, et al.[8]; glutamic-pyruvic transaminase (GPT), according to Wroblewski and La Due[9]; and lactic dehydrogenase (LDH) and malic dehydrogenase (MDH), by the method described by Tyler.[10] GOT, GPT, LDH, and

MDH values are all reported as units of activity, one unit being an optical density change of 0.001 per minute at 25° C. Esterase is reported as micromoles of substrate hydrolyzed per gram of wet tissue per hour.

Results

The normal tissue values obtained for the enzymes studied are shown in Table I. These results are included here primarily to illustrate the relative enzyme activities in the various tissues. Standard deviations are included in the table. As one might expect, the serum enzyme levels are, in general, quite low compared with tissue enzyme levels where active metabolism is taking place. Serum LDH and MDH activities are quite comparable while GOT activity is about 10 times greater than that of GPT. Liver has the highest level of activity for each of the enzymes studied. Liver esterase activity in rats as determined by this method is somewhat variable. With different groups of rats occasional liver esterase values were found to be as high as 12,000 to 14,000 μM/gm/hr in normal animals. This variation, however, would have little effect on the data to be presented in Table I, which shows that liver esterase values drop to extremely low values following CCl_4 exposure. Brain has comparatively high levels of LDH, MDH, and GOT, but esterase activity appears quite low when compared with the other tissues. The level of these enzyme activities in the normal adrenal gland shows nothing unusual. In all tissues studied, MDH activity is considerably greater than that of LDH, and GOT activity is somewhat above the GPT levels.

Table II illustrates the changes in serum and tissue enzyme activities resuting from exposure to 6000 ppm of CCl_4 vapor for a period of six hours. (The underlined values are significantly different from the controls at the 5% level.) The results are presented as percent of control levels, control levels being 100%. Thus the increase in serum LDH activity to 1080%, 24 hours after exposure to CCl_4 vapor, is a level 10.8 times that of control animals. Forty-eight hours after exposure this high level of serum LDH has not only disappeared but the activity has dropped to 23% of control values. Serum MDH activity was 2850% of control levels 24 hours after exposure to CCl_4 and at 48 hours had dropped almost to normal (163%). GOT and GPT values are even more markedly elevated 24 hours after CCl_4 exposure, rising to levels 56 and 92 times those of control animals. At 48 hours both serum GOT and GPT levels have decreased but are still well above control values. Serum esterase is 395% of the control level 24 hours after CCl_4 exposure, but at 48 hours, like MDH, it has dropped well below normal levels (34%).

In contrast to the serum enzyme increases noted above, liver enzyme levels are generally decreased following exposure of rats to CCl_4 vapor (Table II). Twenty-four hours after exposure, liver LDH, MDH, and GPT values are approximately 60% of normal levels while liver esterase has dropped to the extremely low value of 12%. Liver GOT appears to be an exception in that it is somewhat elevated (169%) 24 hours after exposure. Forty-eight hours after exposure, liver LDH has returned to normal levels, while MDH, GPT, and esterase activities remain depressed. It is interesting to note that 48 hours after exposure liver esterase has practically disappeared, dropping to 6% of control levels. Since the liver enzyme levels have been reported on the basis of wet weight of liver, variations in glycogen and fat content could alter these values. For this reason enzyme activities were also calculated for the whole liver. The changes in enzyme activities calculated on the basis of the whole liver vary from the present values by less than 10%.

Body fat of exposed rats shows a slight increase in the levels of all enzymes studied (Table

TABLE I

NORMAL ENZYME LEVELS IN THE SERUM AND TISSUES OF ADULT RATS

Tissue	LDH*	MDH*	GOT*	GPT*	Esterase†
Serum	1.8 ± 1.1	1.4 ± 0.6	0.16 ± 0.02	0.02 ± 0.02	68 ± 5
Liver	179 ± 5	707 ± 12	122 ± 9	76 ± 1	6285 ± 775
Fat	3.2 ± 0.3	41 ± 5	2.0 ± 0.5	1.3 ± 0.2	146 ± 17
Adrenal	28 ± 2	378 ± 50	17.7 ± 2.7	5.3 ± 0.6	82 ± 16
Brain	81 ± 16	653 ± 60	68 ± 11	13.0 ± 1.5	8.7 ± 0.2

Standard deviations are included.

*Value x 1000 = units of activity per gram of wet tissue (ml. of serum). (One unit is an optical density change of 0.001 per minute.)

†Micromoles of substrate hydrolyzed per gram of wet tissue (ml. of serum) per hour.

TABLE II

THE EFFECT OF A SINGLE SIX-HOUR EXPOSURE TO SIX THOUSAND PARTS PER MILLION OF CARBON TETRACHLORIDE VAPOR ON RAT SERUM AND TISSUE ENZYME LEVELS

All values as percent of control levels (control = 100%).

Tissue	LDH		MDH		GOT		GPT		Esterase	
	24*	48*	24	48	24	48	24	48	24	48
Serum	1082	23	2850	163	5560	4670	9220	4550	394	34
Liver	64	97	65	63	170	165	62	50	12	6
Fat	135	150	160	142	246	523	121	110	154	128
Adrenal	106	130	90	136	100	135	139	131	144	100
Brain	102	89	100	98	112	103	117	114	142	114

*24 and 48 hours after a 6-hour exposure to 6000 ppm of CCl_4. Underlined values are significantly different from the controls at the 5 percent level.

II). GOT in fat exhibits the greatest increase, rising to 523% of control levels 48 hours after exposure.

The effect of CCl_4 exposure on the levels of these enzyme activities in the adrenal gland is not marked (Table II). Slight increases are noted in the levels of each of the enzymes studied.

With the exception of a small increase in esterase level, no marked changes were noted in the enzyme levels of rat brain after a six hour exposure to 6000 ppm of CCl_4 vapor (Table II).

Comment

Serum enzyme activity is markedly affected by exposure of rats to high levels of CCl_4 vapor. In all of the enzymes studied this response is a rapid increase in serum enzyme activity. Bruns and Neuhaus[11] reported a similar increase in serum aldolase and serum phosphohexose isomerase, presumably as a result of tissue damage and release of enzyme into the blood stream. These elevated serum enzyme values rapidly return to normal, and in some cases actually drop below control levels. Serum LDH and esterase values are both well below normal 48 hours after exposure. Since liver enzyme values for LDH, MDH, GPT, and esterase are decreased following CCl_4 exposure, the loss of these enzymes into the blood stream could well account for the elevated serum values. Liver GOT is not depressed, and, in fact, is significantly elevated 24 hours and 48 hours after exposure. Thus the source of serum GOT elevation is not clear at this time, unless this enzyme is released from the liver quite early in the postexposure period and then is rapidly resynthesized by the damaged liver.

Body fat shows a moderate increase in activity of several of the enzymes studied after exposure to CCl_4 vapor. This may be due to an increased metabolic rate during fat mobilization, to a concentration of enzyme by loss of fat from the depots, or may be a reflection of the high blood levels encountered during this period. GPT activity in fat, however, is essentially unaltered even in the presence of high blood levels of this enzyme.

The adrenals show slight elevations of enzymatic activity but no evidence of major changes that would indicate a specific effect of CCl_4 exposure.

With the exception of esterase, the brain enzyme levels which were studied show no significant effects of CCl_4 exposure.

The present results, along with those previously published,[3] show marked changes in the enzyme levels of serum and liver following exposure to high levels of CCl_4 vapor. Body fat, adrenal, and brain included in the present study show moderate increases in several enzyme activities. The magnitude of these changes, however, would seem to indicate that these tissue enzyme levels are not markedly affected by CCl_4 exposure. Enzymes in the livers of rats exposed to CCl_4 vapor show, as a rule, a significant decrease in the level of their activity. The unusual response of an elevated liver GOT activity concurrent with elevated serum GOT needs further clarification. Other tissues are being investigated with respect to their possible contribution to the elevation of serum GOT following exposure to CCl_4 vapor.

The use of serum enzyme levels as an aid in the diagnosis of specific tissue damage has already been of considerable clinical value.[8,9] This application is based upon the release of enzymes from damaged tissue into the blood stream. A major problem in this use is the rapid rate of disappearance of these enzymes from the blood stream. Thus the diagnostic period may be of relatively short duration. The high levels of serum enzyme activity resulting from exposure of rats to CCl_4 vapor return rapidly to normal. A previous report indicates that elevated GOT and GPT levels in serum return to normal values within two to three days.[3]

In the case of LDH and esterase, these enzyme levels exhibit an initial increase and then drop well below control levels so that samples of blood taken at 48 hours would show depressed rather than elevated serum values as a result of liver damage. Such enzymatic techniques, however, show great promise of becoming increasingly important as more specific tissue enzymes are studied and the time relationship between tissue damage and serum levels becomes clarified. Enzymatic methods would appear to be particularly applicable to the determination of subclinical levels of toxicity. With such techniques, the effects of exposure to low concentrations of toxic materials could perhaps be detected before the clinical signs of tissue damage appear.

Summary

Glutamic-oxaloacetic transaminase (GOT), glutamic-pyruvic transaminase (GPT), lactic dehydrogenase (LDH), malic dehydrogenase (MDH), and esterase activities have been studied in serum, liver, brain, adrenals, and body fat of rats exposed to CCl_4 vapor. The enzymes studied show slight changes in activity in fat, adrenals, and brain, but with the possible exception of GOT in body fat, the magnitude of the response is such that there is little to suggest a major effect of CCl_4 exposure on these tissue enzyme levels. However, there does appear to be a direct correlation between the increased

serum LDH, MDH, GPT, and esterase levels and the loss of liver enzyme activity after exposure of rats to CCl_4 vapor. The apparent increased level of GOT activity simultaneously in liver and serum needs further clarification.

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PHS: 1. Office of Resource Development (Environmental Health)

The establishment of an Office of Resource Development (Environmental Health) within the Bureau of State Services has been announced, as another step in the reorganization of the Public Health Service to provide, among other purposes, a more coordinated, integrated, and intensive focus upon the public health problems created by environmental hazards stemming primarily from air and water pollution, exposure to radiation, and occupational and industrial developments.

The Office of Resource Development, which is headed by Frank A. Butrico (Engineer, Director Grade), is a staff arm to Robert J. Anderson, M.D., Assistant Surgeon General and Deputy Chief of the Bureau of State Services.

In an effort to stimulate greater research efforts by the life and engineering sciences in the many aspects of environmental health hazards, a research and/or training grants branch has been established in a number of Divisions within the Bureau, as follows:

Division of Air Pollution, Chief, Research and Training Grants Branch, Dr. Maurice Bender; Division of Environmental Engineering and Food Protection, Chief, Research Grants Branch, Harold B. Robinson; Division of Occupational Health, Acting Research Grants Administrator, Dr. W. Clark Cooper; Division of Radiological Health, Chief, Office of Extramural Grants, Dr. Paul F. Hahn; and Division of Water Supply and Pollution Control, Chief, Research and Training Grants Branch, Harry A. Faber.

PHS: 2. National Dental Health Center

A two-pronged attack on the nation's dental health problems has been launched by the U. S. Public Health Service with the opening of the National Dental Health Center on the grounds of the Public Health Service Hospital in San Francisco.

The Center is operated by the Division of Dental Public Health and Resources. It occupies a former nurses' quarters made available by the Service's Hospital Division.

First of its kind, the National Dental Health Center provides facilities for applied research in the prevention and control of dental diseases and for training dental public health workers in the application of research findings. This dual approach is designed to reduce substantially the time lag between the discovery of new knowledge and techniques and their subsequent use in dental health programs.

For the first year of operation, a staff of 20 has been assigned to the Center, including four Public Health Service dental officers who will be receiving in-service training. Dr. George Nevitt, presently Regional Dental Consultant in HEW Region VII, directs the Center and its training activities. Dr. John Greene, now a graduate student in epidemiology at the University of California, will head the epidemiology program. As the Center expands over the next five years, a program of applied research touching many phases of dental health will be conducted.

Accidental Vapor Exposure To Anesthetic Concentrations Of a Solvent Containing Tetrachloroethylene

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Tetrachloroethylene and solvent solutions containing tetrachloroethylene are widely used in industrial cleaning operations. When overexposure is suspected to have occurred, and the vapor concentration during the exposure is unknown, the immediate clinical estimation of the magnitude of the exposure is apt to be unreliable. Under these circumstances, important intrinsic causes for syncope or coma may be overlooked while the patient is being treated for a supposed overexposure to tetrachloroethylene.

The major obstacle which has prevented an unequivocal diagnosis of tetrachloroethylene exposure and an estimate of the magnitude of exposure, has been the lack of a practical analytical method for the quantitative identification of this compound in the blood or the postexposure expired air. The recent development of infrared methods for the analysis of specific chlorinated hydrocarbons in blood and in the expired air[1,2,3] makes possible a more accurate medical evaluation of the exposed patient and should encourage the reporting of exposures to this type of compound.

The purposes of this paper are, first, to report a case of acute overexposure to vapors of a solvent containing 50% tetrachloroethylene and 50% Stoddard solvent in which it was possible to simulate and measure the exposure; second, to identify and quantitate by a practical infrared method the tetrachloroethylene in the expired air of the individual who was exposed; third, to correlate the concentration of tetrachloroethylene in the expired air with the degree of exposure; and fourth, to compare this correlation with results obtained from controlled human exposures.

Case Report

History: A 21 year old white male, the employee of a building contractor, was brought by ambulance to The Dow Chemical Company Medical Department after he lost consciousness while working in high vapor concentrations of a "solvent" which contained approximately 50% tetrachloroethylene and 50% Stoddard solvent. The patient was alternately cleaning steps with the solvent, and mixing cement in an area where very high concentrations of solvent vapor were present. Because the working area was poorly ventilated, an auxiliary air hose was employed which accounted for one air change per hour. Shortly after beginning his work, the patient noted marked eye irritation and lightheadedness. On three occasions he became "too woozy" and left the area "to catch a breath of fresh air." Within three to five minutes his lightheadedness cleared sufficiently to allow him to return to his work.

Because of an annoying whistling sound

produced by the air hose, it was turned off by the patient. Thirty minutes later he slumped to the floor. A fellow workman noted he was unconscious and immediately carried him from the area. The patient had been exposed over a three and one half hour period and had used approximately one gallon of the solvent. The past medical history and review of symptoms, when obtainable, were found to be noncontributory to the present illness.

The actual job being performed by this man was helping to resurface 27 steps in the hopper room of a power house. His first operation was to remove all dirt and grease from these steps. Step-cleaning commenced at the top of the stairs. Three steps were cleaned at a time using the solvent poured from a gallon can onto the steps, followed by scrubbing with rags. This operation took 15 minutes and the dirty saturated rags were thrown on a heap at the bottom of the stairs. The worker then descended to the bottom of the stairs for 15 minutes to prepare a cement mixture for the resurfacing procedure. Then the cycle was repeated with the next three steps being cleaned.

Physical Examination: The patient was a well-developed white male in a semicomatose state. His breath had a strong odor presumed to be that of a chlorinated hydrocarbon. His blood pressure was 140/80 mm Hg., right arm recumbent, and his pulse rate was 75 per minute and regular. His respiratory rate was 20 per minute, lungs were clear to auscultation, and his heart was normal. The liver was not palpable. No scleral icterus was noted. None of the physical findings suggested that portal cirrhosis was present.

Clinical Course: Oxygen was administered by mask for 15 minutes. At the end of this time the patient was observed to be completely conscious and rational. A neurological examination performed one hour after his collapse disclosed no abnormality of function. The patient was allowed to go home that evening and was followed closely for six weeks. During this interval he did not develop anorexia, nausea, vomiting, clinical jaundice, or neurological symptoms.

Experimental Procedure

Simulated Exposure: One of the authors (A. W. S.), wearing an air-supplied respirator, simulated the exposure conditions of the patient and measured the vapor concentrations of both tetrachloroethylene and Stoddard solvent during each 15 minute interval.

Method of Environmental Analysis: Solvent vapor was adsorbed on silica gel, with subsequent desorption, combustion, and analysis for halocarbon concentration by Volhard titration.[4] Air samples were also collected in Saran bags and were analyzed for tetrachloroethylene on a Perkin-Elmer Model 12C infrared spectrometer equipped with a 10 meter path-length gas cell. The absorbance of the characteristic band at 10.9μ was measured to determine the concentration of the compound. A J and W Aromatic Hydrocarbon Detector was used for the determination of Stoddard solvent.

Analysis of Expired Air for Tetrachloroethylene: Serial expired air samples from the patient were collected in six-liter Saran bags. The bagged air was allowed to flow into the evacuated 10 meter path-length gas cell, and was scanned on the Perkin-Elmer Model 12C spectrometer through the 10.9μ region. The minimal amount of the compound detectable in the expired air was 0.25 ppm with an accuracy of $\pm$ 0.2 ppm.

Postexposure Clinical Laboratory Studies: In the postexposure period the following clinical laboratory studies were obtained at appropriate intervals and are listed in Table I: complete blood count, urinalysis, urinary urobilinogen, serum bilirubin, alkaline phosphatase, thymol turbidity, cephalin flocculation, bromsulfalein retention (BSP), serum glutamic oxaloacetic transaminase (SGO-T), serum glutamic pyruvate transaminase (SGP-T), and tetrachlorothylene concentration in expired air.

Results

The tetrachloroethylene concentration in the patient's expired air is graphed on log-log paper in Figure 1. The lower curve on this graph represents the expired air concentrations of six human subjects exposed experimentally in a previous study to tetrachloroethylene vapor, 194 ppm for 3 hours.[3]

The simulated exposure revealed that the average concentration of tetrachloroethylene in the work environment during the three hour and 30 minute exposure period was 393 ppm. The average concentration of tetrachloroethylene while cleaning 21 stairs (exposure of one hour and 45 minutes) was 326 ppm while the average concentration found at the bottom of the stairs while mixing the cement was 458 ppm. The average exposure for the first three hours was 275 ppm. The exposure for the remaining 30 minutes with the air hose turned off was 1100 ppm. Concentrations of tetrachloroethylene ranged between 25 and 1470 ppm.

The average concentration of Stoddard solvent during the exposure was 230 ppm, and concentrations ranged between 70 and 425 ppm. It seems doubtful that these concentrations contributed significantly to the patient's physiological symptoms.

TABLE I

Postexposure Clinical Laboratory Studies

Laboratory Study	Normal Values	Days Postexposure 1	2	3	7	9	10	14	16	17	18	21	44
Urinary Urobilinogen	1:40 dilution or less	1:10				1:320	1:320	1:10	1:40		1:10		
Serum Bilirubin	Total: 0.7 mg % Direct: 0.4 mg %					Total: 3.2			Total: 0.7 Direct: 0.3		Total: 2.0 Direct: 0.8		
Alkaline Phosphatase	2.0-4.5 Bodansky units							6.2	4.1		4.2		
Thymol Turbidity	0-4 units							1.6	1.1		1.1		
Cephalin Flocculation	2- 12 48 hr.							Neg. 48 hr.	Neg. 48 hr.		Neg. 48 hr.		
Bromsulfalein Retention	Less than 5% at 45 min.					4.0							3.0
SGO-T	24 ± 16	23	28			25	20	18	23		30		
SGP-T	19 ± 11							23	27		31		
Tetrachloroethylene expired air concentration	0 ppm	18	8	6	3	2	1.5	0.7	4.5	0.8	0.4	0.2	
Complete Blood Count								RBC 5.21 Hbg. 15.6 WBC 9,150 PMN - 59% LYM - 33% EOSIN - 4% MONO - 4%	RBC 4.94 Hbg. 15.4 WBC 5,900 PMN - 55% LYM - 40% EOSIN - 3% MONO - 4% BASO - 1%				
Urinalysis								Sp. gr. 1.030 Alb. neg. Sug. neg. Micro: 1-2 WBC/HPF rare RBC	Alb. neg. Sug. neg. Micro: 0-1 WBC/HPF rare RBC		Sp. gr. 1.025 Alb. neg. Sug. neg. Micro: 1-2 RBC/HPF		

Discussion

Two significant observations were made while studying the postexposure clinical course of this patient. The first observation was that tetrachloroethylene had an exceedingly prolonged exponential "decay" in the postexposure exhaled air. The second observation was the laboratory evidence of impaired liver function which became manifest nine days following the exposure.

It is the authors' belief[3] that for daily exposures of seven to eight hours the vapor concentration of tetrachloroethylene should not exceed 200 ppm, and the average time-weighted exposure should not exceed 100 ppm. In Figure I, taken from a previous experimental study, the decay curve (average concentration in expired air *vs.* time) of tetrachloroethylene concentration in the expired air of six subjects exposed to 194 ppm for 183 minutes[3] is presented for comparison with this patient's expired air decay curve. It is apparent from these data that analysis of the patient's expired air at any time in the two weeks following exposure would have indicated that a significant overexposure had occurred. In addition, the use of the infrared method would have allowed a positive identification of tetrachloroethylene.

One other point merits emphasis at this time. While it is true that many groups of organic compounds, such as the halogenated hydrocarbons, absorb strongly in the infrared region, some do not. Stoddard solvent, an aliphatic hydrocarbon mixture, was not detected in the patient's postexposure exhaled air. While this mixture has a moderately strong absorption band at 3.4μ, it is doubtful that it could be detected at concentrations of less than 20 ppm by the method used.

This rapid infrared method has proved useful for the analysis of other chlorinated hydrocarbons in the expired air as well as for other volatile compounds possessing strong absorption bands in the infrared region. The method usually allows for the specific identification of the organic compound or mixtures of compounds present. The method is simple in that no sample preparation is required other than the collection of the expired air, and the infrared analysis is a rapid, reliable procedure in the hands of the average laboratory technician. Expired air samples may be stored in Saran bags until the time of infrared analysis. Thus, samples may

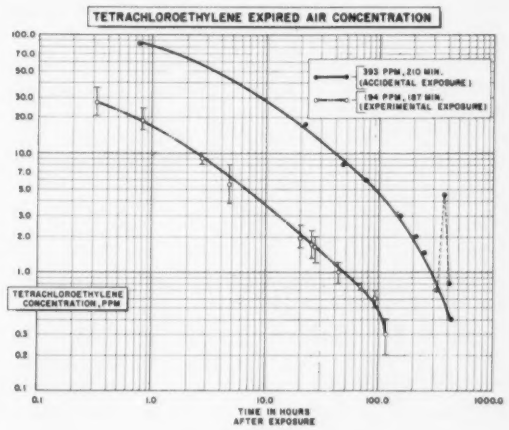

Figure I

Tetrachloroethylene expired air concentrations following vapor exposure. In the six-man experimental exposure, mean concentration and range are plotted.

be collected in areas where infrared facilities are not available, and then sent to an appropriate laboratory.

Following his apparent clinical recovery, one hour after exposure, the patient remained completely asymptomatic. On the ninth postexposure day both the urinary urobilinogen and the total serum bilirubin were observed to be elevated. The urinary urobilinogen was within the normal range by the fourteenth postexposure day, but a slight elevation of the alkaline phosphatase was noted. On the sixteenth day the tetrachloroethylene concentration in the exhaled air was observed to be sharply elevated. Although the patient denied any additional exposure, it is possible that some exposure occurred without his knowledge. This was probably of minor magnitude in that the over-all decay curve slope was not altered appreciably. On the eighteenth day the SGP-T was minimally elevated. On the twenty-first day no tetrachloroethylene could be detected in his expired air.

This patient's clinical course and laboratory studies emphasize several points. First, an acute exposure to tetrachloroethylene may be, in fact, a chronic exposure from the body's standpoint because of the compound's slow excretion rate. Second, liver function studies may become abnormal during the second and third weeks following overexposure at a time when the patient is completely asymptomatic. The laboratory evidence of impaired liver function supports the contention that the brief overexposure had subjected the liver to a continuous, two and one half week insult. Third, the liver function studies most sensitive to the insult were the urinary urobilinogen, the alkaline phosphatase, the serum bilirubin and the SGP-T. Fourth, since the lungs are a major excretory organ for tetrachloroethylene, it would probably be efficacious to administer oxygen and carbon dioxide to stimulate deeper respiration and thus provide a more rapid excretion rate in the early hours following exposure.

Finally, because overexposure exerts a chronic effect upon the body, the patient should not be allowed to experience additional exposure until the expired air concentration is low and all liver function studies are normal.

Summary

The clinical course of a worker accidentally overexposed to anesthetic concentrations of an industrial solvent containing tetrachloroethylene and Stoddard solvent is presented. While the duration of exposure was brief and apparent clinical recovery rapid, the tetrachloroethylene vapor concentration in the patient's expired air diminished exponentially over a two week period. Liver function studies became abnormal during the second and third postexposure weeks. This suggests that an acute exposure to this solvent has a chronic effect upon the liver and is capable of producing a mild hepatitis.

Determination of the concentration of tetrachloroethylene in expired air at any time during the two week postexposure period would have demonstrated that overexposure had occurred. Thus, analysis of expired air offers a method whereby the magnitude of exposure may be reasonably estimated long after suspected overexposure has occurred.

The use of infrared spectroscopy to analyze the expired air provided for absolute identification of tetrachloroethylene, and proved to be a sensitive, rapid method with which to measure the compound.

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Treatment of SUPERFICIAL FUNGOUS INFECTIONS With Griseofulvin

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Victims of superficial fungous disease, although not occupationally disabled, are rarely able to work at optimal efficiency. In addition to the physical discomforts produced by these infections, the patient is subjected to his fellow employees' ill-concealed (although ill-founded) fear of contagion. Often cases of tinea are first seen by the industrial physician and many can be managed in the industrial medical facility. The availability of a convenient, relatively safe, and highly effective oral agent for superficial fungous infections has considerably simplified the task of the industrial physician who assumes responsibility for treatment.

The first clinical reports[1,2,3] of the effectiveness of griseofulvin, a metabolite of species of Penicillium,[4,5,6,7] initiated what has since become a profuse literature describing favorable experience in the treatment of tineas of the hair, glabrous skin, and nails caused by species of Epidermophyton, Microsporum, and Trichophyton. Our experience with griseofulvin in the treatment of 54 patients with these fungous diseases is reported below.

Method

The series consisted of 14 children, between three and nine years of age, and one adult female with tinea capitis; 11 adults with tinea corporis or cruris of whom eight had been infected for at least one year; nine adults with chronic tinea pedis and "id" reactions on the hands or nail changes; five adults with tinea unguium; and 14 adults with uncomplicated chronic or recurrent tinea pedis. M. audouini (11 patients) or M. canis (two patients) was responsible for the scalp infections and C. albicans (one patient), E. floccosum (12 patients), T. mentagrophytes (four patients), or T. rubrum (13 patients) was responsible for infections of the skin and nails. Attempts to identify the infecting organism were unsuccessful in the other 11 patients.

Scrapings taken from infected areas were stained with potassium hydroxide and examined microscopically before and during treatment. Cultures were grown in Sabouraud's dextrose agar medium. Patients were examined weekly. The criterion for cure was clinical regression confirmed by laboratory examination. No patient was considered cured if there had been a recurrence or an untoward reaction requiring discontinuance of therapy.

The usual dosage* was 250 mg. griseofulvin four times daily until cure or until it became obvious that cure was unlikely.

Results

Therapy succeeded in 34 patients (63%) and failed in seven patients (13%); 13 patients (24%) did not complete treatment (Table I). Three of the failures were recurrences after apparent cure.

Seven of the 14 children with tinea capitis were cured within four weeks, by which time laboratory and Wood's light examinations were negative. Significant improvement became clinically evident during the second or third week. The other seven children could not be evaluated

*Griseofulvin (Fulvicin ®) was made available for this study through the courtesy of G. Kenneth Hawkins, M.D. of the Medical Research Division, Schering Corporation, Bloomfield, New Jersey.

because of insufficient follow-up. The adult female with tinea capitis, who was pregnant, did not complete therapy because of headache and light-headedness and this result was considered a failure.

Tinea corporis or cruris responded rapidly and usually major improvement was noted after the first or second week. Eight of these 11 patients were clinically and mycologically cured within five weeks. One patient was lost to follow-up and two patients did not improve.

Eight of the nine patients with tinea pedis and "id" reactions on the hands showed clearing of the lesions, usually within eight weeks, and one patient was lost to follow-up. Two patients had recurrences, four and eight weeks after discontinuance of medication, and were considered as failures. One patient reported gastrointestinal distress during therapy but was able to tolerate a lower dosage, with satisfactory therapeutic results.

Four of the five patients with tinea unguium are responding slowly but satisfactorily and are being continued on griseofulvin until the infected nail is entirely replaced with healthy growth. Major improvement usually was evident after four months of treatment. One patient did not continue.

Of the 14 patients with tinea pedis, 10 showed satisfactory clearing of the lesions within one to eight weeks. The infection recurred in one of these patients two weeks after griseofulvin had been discontinued. Three patients were lost to follow-up and one did not improve.

TABLE I.
DIAGNOSES AND RESULTS

Clinical Diagnoses	Laboratory Diagnoses	Total Treated	Cured	Failed	Incomplete
Tinea Capitis (15)	M. audouini	11	5	—	6
	M. canis	2	2	—	—
	Unobtainable	2	—	1*	1
Tinea Corporis and Cruris (11)	C. albicans	1	—	1**	—
	E. floccosum	2	1	1**	—
	T. mentagrophytes	1	—	—	1
	T. rubrum	4	4	—	—
	Unobtainable	3	3	—	—
Tinea Pedis and Manuum (9)	E. floccosum	2	1	1***	—
	T. mentagrophytes	1	1	—	—
	T. rubrum	6	4	1***	1
Tinea Unguium (5)	T. mentagrophytes	1	1	—	—
	T. rubrum	2	2	—	—
	Unobtainable	2	1	—	1
Tinea Pedis (14)	E. floccosum	8	6	—	2
	T. mentagrophytes	1	1	—	—
	T. rubrum	1	—	1***	—
	Unobtainable	4	2	1**	1
	Total	54	34 (63%)	7 (13%)	13 (24%)

*side effects
**true failures
***recurrences

Comment

Cases of tinea capitis due to M. audouini or canis can be expected to respond rapidly to griseofulvin. Morphological changes in the fungi occur as early as the first or second week.[8] We have had no true failures in this group. Clipping the hair, frequent washing, and application of topical antifungal medication can expedite cure. Negative cultures and Wood's light examinations confirm the clinical cure.

Tinea corporis and cruris also respond favorably to griseofulvin. Pruritus disappears rapidly and lesions diminish in size and severity. The first negative cultures usually are obtained within one month. When the hyperkeratotic soles or palms are invaded, more time is required for cure because tissue replacement occurs more slowly. Recurrences apparently are more frequent in this area. Continuing treatment with griseofulvin for a few weeks after clinical cure might help to prevent recurrence.

The minimum period of treatment for tinea unguium is four months. The toenails grow even more slowly than the fingernails, and an especially long duration of therapy can be anticipated before the entire nail is free from infection.

Only one patient discontinued the drug because of an untoward reaction and side effects were not a problem. Some patients will have headaches or gastrointestinal distress[7,9,10] but these effects tend to disappear spontaneously and therefore premature reduction or discontinuance of the drug is not necessary. Rarely, an urticarial eruption appears during administration of griseofulvin. A history of penicillin sensitivity is not a contraindication.

Laboratory values tend to remain constant during and after administration of griseofulvin.[9,10,11,12] Rarely, a transient and apparently insignificant albuminuria or a slight fall in the leukocyte count is observed, but these findings do not persist after the drug has been discontinued.

Because some nonfungous dermatoses are clinically indistinguishable from tinea, it is important to verify a clinical diagnosis of fungous infection by microscopic examination of scrapings. The infecting organism should be identified in culture when possible so that administration of griseofulvin is confined to patients with infections due to species of Epidermophyton, Microsporum, and Trichophyton.

Griseofulvin unfortunately is not active against M. furfur or C. albicans; the latter organism causes moniliasis, a fungous disease with a relatively high incidence among persons whose work requires prolonged immersion of the hands

in water. One of our three true failures was in a patient with C. albicans infection and another was in a patient for whom the infecting organism could not be identified and might also have been C. albicans. The third failure was in a patient with E. floccosum infection. All of our cases of Trichophyton and Microsporum infections responded to therapy.

Summary

Griseofulvin (Fulvicin) was used to treat superficial fungous diseases of the scalp, skin, or nails in 14 children and 40 adults. The usual dosage was 250 mg. four times daily.

Cures, apparently permanent, occurred without side effects in 34 patients. Results were unsatisfactory in one patient because of side reactions, in three patients who did not improve after a reasonable period of therapy, and in three patients who had recurrences of the infection several weeks after griseofulvin was discontinued. Therapy was not completed in the other 13 patients.

Our results indicate that tinea capitis, corporis, and cruris usually can be cleared in one month; tinea pedis requires up to two months, and tinea unguium must be treated for at least four months.

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Have a Safe Summer

Family Recreation and Safety — 1961, an 80 page guide to safe recreational activity, has just been issued by New York University's Center for Safety Education. The digest-size booklet contains 18 articles describing effective precautions designed to contribute to the security of summer sportsmen and vacationing Americans. The articles range from the proper handling of firearms to safety factors in skin and scuba diving.

In his introductory article, Dr. Walter A. Cutter, Director of the NYU Center, notes, "Every season, we become accustomed to reading about drownings, firearm accidents, and falls, while individuals were out 'having fun.' These tragedies seem all the worse because they happened while people were supposedly enjoying themselves."

Included in the booklet are articles entitled: "Water Skiing-Safely," "The ABC's of Gun Safety," "Organizing the Family Vacation Trip," "Do-it-Yourself Activities Around the Home," "Motor Boating with Built-in Safety," and "Camping by Car and Trailer." The last article, "Fitness—for Recreation," deals with physical, emotional, and social fitness as they relate personally to the safety factor.

Copies of the booklet are available at $1, or $.75 for 10 or more. They may be obtained from the Center for Safety Education, Division of General Education, 4 Washington Square North, New York 3, N. Y.

The editors of *Family Recreation and Safety* state that the book will be especially valuable to industrial establishments interested in off-the-job safety of employees, as well as to safety educators, civic groups, and private individuals.

The Center for Safety Education, a unit of NYU's Division of General Education, provides instruction in the main areas of accident prevention. The courses prepare people for the administration of accident prevention programs and procedures.

The author discusses the incidence of bovine type tuberculosis in the Federal Republic of Germany and other countries of Western Europe since World War II. He outlines the various methods employed for the eradication of this disease that is a hazard to the consumer and to the dairy worker as well.

Bovine Tuberculosis as an Occupational Risk

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The bovine type of the bacterium tuberculosis which causes infection in cattle is also a pathogen for men. In Germany before World War II, approximately 1,000 people died annually of infection with the bovine type of tuberculosis. Now, the number is 1,800 every year in the much smaller Federal Republic of Germany, accounting for 10% of all deaths caused by tuberculosis in human beings.

The frequency of infection with the bovine type of tuberculosis is, of course, dependent on the frequency of the infection in animals, and in Germany this rate is extremely high. Before the second World War 98.88% of the cattle in the larger herds were infected (de Rudder). The dairyman with 20 cows on his hands ran a greater risk than, for instance, a small farmer with one or two cows. In 1951, still 63% of the livestock in the Federal Republic of Germany were infected, including 37% of all cattle older than one year (Trendtel). Milking cows show the highest rate of infection, the average being 40%, and even in some high quality stocks the rate is 70 to 80% (Fortner). This means every second milking cow is secreting bacteria tuberculosis. And most of the German stocks are not under regular health supervision. The danger of infection with tuberculosis by cattle is greater than the risk of infection in a hospital specializing in lung diseases (Jensen).

The coughing of bacteria by cattle and the inhalation of dust in stables which is mixed with these bacteria can lead to infection and constitutes a professional risk, especially for milkers and other farming staff, as well as for veterinary surgeons and their assistants, meat inspectors, slaughter house employees and others.

Rates of infection of farmers vary. The Dane, Sigurdson, registered 43% among Danish farmers in 1942 before the clearing up of the Danish stocks; the Swede, Magnusson, mentioned 51% in 1939; the German, Höft mentioned 83.3% in 1955, whereas English authors such as Munro, Griffith and Cutbill mention only 4.7 to 16.4%.

Considering all this, the number of reported cases of tuberculosis caused by professional risk is relatively small. The greatest number of cases are traced to the consumption of dairy products, primarily milk, containing bacteria. After entering the human body the bacteria mostly grow in the lower parts of the ileum, and naturally children have the highest rate of infection. Also, the meningitis tuberculosa is caused to a certain extent by the bovine type, the lethal rate for which is given as 50% for England.

Tests of sold milk of a modern German dairy showed 6.4% living bacteria tuberculosis; those of another teaching and testing dairy figures around 3.2% (Wagener, 1951). The frequency of living bacteria tuberculosis in the milk reaching the dairy depends upon the quantity of the bulk in which the milk is collected. The bigger the bulk, the more bacteria. In some places the dairies found from 30 to 50% living bacteria tuberculosis, and this despite the regulation to report all cases of tuberculosis of the udder (Wagener). Therefore, it is still risky in Germany to drink raw milk (Fortner). Since short time pasteurization is not sufficient for devitalization of bacterium tuberculosis, it is necessary to heat the milk to 85 degrees Centigrade at least for one minute.

Interesting results of bacteriologic milk tests are reported by Kathe: 39% of the collected milk contained bacteria tuberculosis; 18% of the pasteurized milk, "Markenmilch," 16%; short time heated milk, 13%; and "Vorzugsmilch" (from health controlled stocks), 3%.

Tuberculosis of the intestines caused by drinking such milk is not recognized as a professional disease, except among farming staff when the people get milk as part of their pay.

Goerttler and Weber summed up 93,000 cases of infection with the bovine type of bacterium tuberculosis from the world literature and found that the intestines were affected in 36.6% of the cases, and, in 40.3%, the glands of collum and axillae were affected. The percentage of lung involvement was comparatively small.

It is a pity that doctors do not consider more often the possibility that lung infection may be with the bovine type. The primary infection with this type is followed in most of the cases by a typical primary affection. "Primary affection in grooms" is recognized as a special form of the disease in Sweden and Denmark.

There is no visible difference between infection with human or bovine type; they are both pathogen and apart from diseases of the lungs they can cause diseases of the skin, the bones, the joints and kidneys.

In order to identify tuberculosis as an occupational disease, it is important to consider the case history, the professional risk, and the obligate x-ray. For a safe diagnosis the bacteriologic test is essential. There are significant differences between human and bovine type in aspect and in form of growing in culture medium. It is essential for an accurate test that the bacteria taken from a human or animal body be put to the culture medium immediately, and even then differentiation sometimes is difficult.

This difficulty of recognition of the type has often interfered with the diagnosis as an occupational disease. In the same way, all cases of infection with the bovine type without expectoration of bacteria are difficult to diagnose. Another problem concerns mixed infections, with expectoration of both types. Here it is difficult to decide whether the superinfection with the bovine type has mobilized a sleeping infection with the human type. In most the cases a decision is impossible.

Also, mutation of the type must be taken into consideration. This was reported on by Ferrán of Spain and defended by Enderlein, Drevermann, Lexer-Rehn, and others. Briefly, the theory of mutation is that a bovine type bacteria, after a living certain time in a human body or under equivalent conditions, could change its characteristics completely into those of the human type and vice versa. Oehlecker, however, says the mutation cannot be proved, and in these cases there is always a mixed infection.

Summing up, I would like to say that the positive bacteriologic test on the bovine type proves the professional infection, and finding the human type does not always negate this professional infection because cattle can also bear and spread the human type (Meyn). Following the Scandinavian literature, the human type is found in 5% of cattle (Haaselmann). But one should know that cattle infected with the human type do not show any visible symptoms but only form a sensibility (positive tuberculine test). Goats react differently; they develop a heavy tuberculosis of the lungs, showing caves, after infection with the human type. On the other hand, it is remarkable that people bearing the bovine type can be a source of infection for cattle. Christiansen reported from Jutland, the continental part of Denmark, on 107 people who infected 1,183 cattle in stocks otherwise free of tuberculosis from 1943 to 1952.

The best prophylactic is the killing of infected cattle. In Germany the procedure for 40 years, after a system recommended by the veterinary surgeon (V. Ostertag,) was to kill all cattle suffering from open forms of tuberculosis and secreting bacteria through lungs, udder, or intestines. This system has cost millions and has had no success, as only advanced cases of the disease were recognized. The Scandinavian countries and Switzerland went to the other extreme and killed all cattle giving a positive reaction on tests with bacterium tuberculosis. Thus, Denmark is free of bovine tuberculosis; that is, since January 6, 1952, there have been no cattle having positive tuberculine reactions. In Switzerland the livestock was freed from tuberculosis by the first of October, 1960, after 10 years of struggle. Of 1.6 million cattle, 360,000 had to be killed.

In Germany, following the recommendations of the veterinary surgeon Müssemeier, the plan now is to free the livestock from tuberculosis by construction of new types of stables and by feeding newly born calves on cooked milk from the very beginning. Testing with tuberculine will also be instituted. Infected animals will be eliminated by isolation or by killing, for it was found by numerous tests that the secretion of bacteria by animals giving positive tuberculine reactions cannot be stopped. In Germany, 45 to 50% of milking cows give a positive reaction; that means every second cow is spreading bacteria (Laugwitz, 1957).

The test is carried out by injecting the tuberculine subcutaneously; the infected animal develops a swelling at the point of the injection within three days, whereas this swelling is missing in healthy animals. Trendtel reports that only negative cattle have been marketed since the fight against tuberculosis was reinforced, but it is his opinion that many of these cows had tuberculosis. In many cases the farmers try to cheat by injecting solutions of sodium chloride before the veterinary surgeon injects his tuberculine, thus assuring negative test results.

Former action to fight the tuberculosis of cattle in Germany failed because it was based on the wrong hypotheses. Before 1952, the Federal Republic of Germany suffered losses amounting to 275 million marks from this disease. But after eight years of planned action, the end of this pestilence can be seen. There was good progress during the last years in eliminating this disease. On January 1, 1958, 66.4% and on June 30, 1958, 74.2% of the livestock were officially recognized as being free from tuberculosis. By January 1, 1961, the figure had risen to 95.7%. Therefore, the reorganization of all herds, which is already completed in Scandinavian countries and Switzerland, can be expected within the next few years in Germany.

It should not be forgotten that other domesticated animals also can be the source of infection with bovine tuberculosis. Not so seldom pigs fed on milk are infected. Goats can spread bacteria, and 11% of cats as well as 6% of dogs carry the disease. Parrots in pet shops and animals in zoos can be infected and a source of danger for their keepers. Guinea pigs with human type tuberculosis infected a biologist, and in another case dogs, which are infected with the human type tuberculosis up to 70%, infected their keeper. Both cases were recognized as professional disease (Laugwitz). Several cases are reported in which dogs and cats spread infection by biting, and approximately three and a half months after being bitten the victims died of miliary tuberculosis of the lungs (Tutenberg, Lewis-Jonsson).

There are no reports in which infection of men with tuberculosis of the galinary type is taken into consideration, despite the fact that these bacteria are found in up to 6% of fresh eggs. Only 40 infections in men with this type are reported (Beitzke), among them the recognized professional disease of a veterinary surgeon (Kreuser). This disease of birds can be robbed of its base, if hens are not kept longer than two years (in any case they do not live that long for economical reasons) and therefore do not reach the necessary age for the disease (Wagener).

The non-human types of tuberculosis still are an acute and multiform problem for certain professions in Germany. Research of the Ministry of Agriculture of the Federal Republic of Germany found the percentage of infection with tuberculosis of the bovine type to be 13.6% (Kleinschmidt). In parts of the south of Germany, farming staff with tuberculous diseases of the lungs showed infection with the bovine type in 19.2% of the cases (Meyn). A lot of work and excellent organization is necessary, if the bovine type tuberculosis is to be eliminated entirely as a professional risk.

INDUSTRIAL HYGIENE FOUNDATION
26th Annual Meeting
October 25-26, 1961
Mellon Institute, Pittsburgh, Pennsylvania

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Water, Vehicles, and Topical Therapy

Undoubtedly, the most common error made when prescribing topical remedies for dermatoses is selecting the wrong vehicle. The behavior of water, as well as of other fluids in the skin, is the key to the action of topical remedies. The vehicles should never be considered inert, because their action alone is quite significant and a proper choice is critical in determining the outcome of treatment. In most situations, the transporting media are as important or more so than the "active" ingredients they carry. Instructions about methods of application and removal and items pertinent to general care are indispensable. Good results may follow proper treatment, even though an exact etiologic diagnosis has not been made. Background information demonstrated scientifically by Irvin Blank[1,2] and known practically for many years by observant, interested practitioners reveals the significance of the water holding capacity of the stratum corneum.

Prophylaxis

Prevention of dermatoses, as of all diseases, is the ideal. However, protective lotions, creams, and ointments have not been as successful as we would like, because no one has developed a preparation selective enough to prevent irritants from damaging the skin and yet to allow for evaporation of perspiration from the skin surface. In addition to meeting this difficult requirement, the protective should be cosmetically acceptable and should not interfere with the performance of daily activities. Silicone and other special preparations devised for this purpose have, for the most part, been disappointing and, for the present, frequent application of creams, the wearing of protective gloves and garments, adequate cleansing, the use of mechanical aids, individual vigilance and common sense are the most satisfactory preventive measures against contact dermatoses, especially those due to primary irritants.

Baths

The nature of baths (full body, sitz, foot, etc.) generally makes them impractical except for hospital or home use. Many materials may be added, but most are useless because the water is the important phase of this treatment. Starch, oatmeal, potassium permanganate, salt, aluminum subacetate, and tars are just a few of the additives commonly used. However, it is the water which does the job of drying for which baths are primarily used. Their action is antipruritic and soothing; a decongestive as well as a cleanser for scale and crust removal. Staining preparations are best avoided as they often obscure the progress of the dermatitis and may ruin valuable receptacles.

It must be remembered that (water) is drying even to the normal skin and this must be taken into consideration when treating older patients. Rarely can baths be used for infants, and debilitated patients must be supervised if baths are prescribed.

Wet Dressings

Wet dressings, open and closed, represent another method of applying water to the skin. More maceration follows when an impervious material (closed wet dressing) is used to impede evaporation than with the open type which is more drying. Sodium chloride, aluminum subacetate, boric acid and potassium permanganate are a few of the chemicals commonly used in wet dressing solutions. Clean, finely woven material such as old sheeting is the best material. In addition to crust removal, drying, and drainage maintenance, most things accomplished by baths may be done with wet dressings.

Shake Lotions

In the dermatologic sense, shake lotions contain powder and an aqueous phase which separate on standing; calamine lotion is a well known example. Though not practical for hairy areas, they are the most useful drying preparations for all age groups and for ambulatory use. Application is best done with the hands or a brush, and the recommended daily removal is accomplished easily and gently with a bath or wet dressings. One can estimate that approximately eight ounces of a shake lotion is required to cover the entire body of an adult.

Presented at the Seventy-Second Annual Meeting of the American Association of Railway Surgeons, Chicago, Illinois, April 7, 1960.

Liquid Emulsions or Liniments

Liquids, the consistency of commercial oily body lotions, that do not settle on standing are the dermatologic prototypes of emulsions or liniments. They may be used on all surfaces including hairy areas, and are the first preparations mentioned that offer lubrication. Composition may vary (i.e., with or without lanolin, viscosity, etc.), and this feature will determine the lubricating value. Daily removal of emulsions is not necessary.

Creams

Ordinary cold or vanishing creams are good examples of this group which may be used on all areas. Being heavier and not as easily spread, they impart a greasy feel to the body, and therefore their use on large surfaces is not as practical as the use of liquid emulsions. This is particularly true for the ambulatory patient whose clothing may be soiled.

Pastes

When a preparation consists of 50% powder and 50% grease (i.e., petrolatum), it is a paste. The ability to absorb water and yet offer a great deal of physical protection against friction makes paste an excellent choice for the treatment of diaper area dermatitis, bed sores, and varicose ulcers. If necessary, pastes are best removed gently with the use of wet dressing or an oil. Unfortunately, this base is not utilized as much as it should be, particularly in the situations cited.

Ointments

If the greasy phase of any preparation is more than 50% of the total, an ointment is created. This is the only topical preparation that will not incorporate into itself or allow for the evaporation of fluid from the skin surface. Some exceptions may occur with so-called water miscible bases, but these are insignificant in the over-all picture. The obvious difficulty of using ointments on hairy and intertriginous areas, particularly during warm weather, need only be mentioned. In addition, the unctuous nature of the material makes it cosmetically undesirable and messy.

Comment

These are the forms or vehicles in which most dermatological preparations are used. Aerosol spray, a more recent arrival, may be placed in the lotion-emulsion sector, depending on whether a lubricant has been added to the solubilized medicament. Tinctures, poultices, powders, and other preparations with more limited application have not been covered.

The order in which these vehicles have been listed and discussed briefly represents roughly the graduated degree to which each vehicle will absorb fluid or allow it to evaporate from the skin. Thus, the ointment is occlusive while the shake lotion causes drying, and only experience will help the physician in choosing the proper remedy. Modifications will be necessary to suit individual problems, such as the use of creams during the day and ointments at night, or shake lotions during the day and wet dressings during the evening. Most dermatological problems are treated on an ambulatory basis, making the cosmetic and esthetic features of the medication unusually important. Unhappy is the executive or lawyer who has been given a greasy preparation for use on the hands during the day, while a watchman may not find its use disagreeable. If one is undecided as to which vehicle should be used, it is preferable to err on the side of making the patient too dry. This state is more easily rectified and is not as risky because maceration, infection, and "absorption id" reactions are more likely to follow the use of occlusive preparations. Fluid trapped beneath ointments may be absorbed through the skin resulting in a generalization of an oozing localized affair.

Many excellent lotions, creams and ointment bases are available commercially. Whether one mixes his own or prescribes prepared dermatologicals, it is wise to use as few remedies as possible. The bulk of cutaneous problems may be treated with no more than 15 preparations and when they are used frequently, the physician should familiarize himself with all aspects of the drugs. This should not preclude trial with new remedies that may eventually replace older preparations but haphazard selection and use are not recommended.

Oily preparations applied to the cutaneous surface relieve dryness. This is done by "plastering down" the rough, scaly surface. More important, if the film is occlusive, evaporation of water from the cutaneous surface is retarded, keeping the stratum corneum hydrated and flexible. The water content of the stratum corneum is more important than oil; and emulsion of both is the ideal in maintaining skin integrity.

Summary

Unsuccessful topical therapy usually follows poor choice of dermatologic vehicles. A review of the commonly used preparations is presented.

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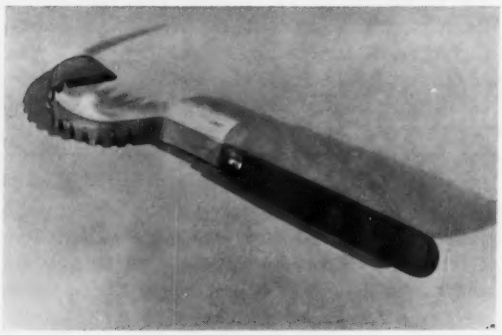
Medically Irrelevant



Is This a Gastric Curette?

This photograph and question appeared in our May, 1961, issue. We now have the answer — No. Several of our readers were kind enough to supply the correct identification; and the first reply came from Mr. Paul Lange of the Employers Mutuals of Wausau, Wisconsin. We are happy to send to him this excellent instrument — a butter curler.

Books

Medical Forms and Procedures for Industry

Herbert L. Herschensohn. $8.50. Pp. 192, 60 illustrations. Charles C. Thomas, Publisher, Springfield, Ill., 1961.

Of all the letters that are seeking information directed to teaching centers in occupational health or occupational health journals, the greater number relate to personnel, medical forms, and procedures. At once this reflects the timeliness of the book here reviewed.

For a long time one of the hopes of industrial medicine has been that in some manner at least some medical forms might be standardized and applied uniformly throughout the country. In fact, the Council on Occupational Health of the A.M.A. has a committee charged with that enterprise. This author, little expecting any early decisions on standardized industrial medical forms, has provided some 60 forms based on his 30 years of experience in large industrial enterprises. Better than that he has assembled an almost endless array of procedures in suggested practices governing almost any situation that might be expected to arise in industrial medical practice.

This author knows full well that the varying requirements of industry will never lend themselves to a fixed set of forms or a fixed set of procedures. His presentations are purely suggestive and modifications as may be required readily may be brought about. It is almost impossible to indicate the range of coverage provided.

Turning at random to the table of contents at one point, and in order, these items appear: Transportation of Patients, Refusal of Treatment, Request for Non-Industrial Treatment, Uniforms, Veterans' Records, Visual Acuity Tests, Injury to Visitors, Vocational Rehabilitation.

As one specific example of the nature and extent of coverage, the practices with reference to radar exposures are here introduced as reflecting the treatment of a hundred other situations:

> Medical Supervisors should notify radar laboratories and the supervision concerned where radar equipment is being used that persons working with such equipment should be cautious in exposing various parts of their bodies to close proximity of radar waves, since these rays have the same effect as diathermy.
>
> There is a possibility of danger when the eyes, genitals and parts of the body in which there are metal implants, especially the skull, are unduly exposed to such radiation. Actually, it is believed there would be danger only when the person is in very close proximity, that is, within a few inches or in actual contact wherein the sensation of heat might be experienced.
>
> Generally speaking, employees are advised to refrain from unnecessarily exposing themselves to radar radiation, preferably staying about ten feet away.
>
> Poor vision should be corrected so that employee does not put his head in dangerous areas to see better.
>
> When 10 cm. radar equipment is in operation all personnel should keep thirty feet from front of airplane.
>
> The following warning is issued by the Secretary of the Air Force:
>
> 1. Avoid exposure to the primary beam of a microwave set at distances less than 200 feet when the antenna is not scanning.
>
> 2. Do not make detailed examination of any microwave radiator, reflector, waveguide opening, or waveguide horn during periods of transmission.

For those physicians in the process of creating an industrial medical department and bewildered at every turn, this book will prove to be manna from Heaven.

Medicina del Lavoro (Industrial Medicine)

Scipione Caccuri. About $14.00. Pp. 725, illustrated. Casa Editrice V. Idelson e F., Napoli, 1961.

"And the whole earth was of one language and of one speech." So says the Biblical Genesis 11 and 1. That language refers to the building of Babel. For reasons unknown that state of affairs displeased Jehovah and Genesis continues: "And Jehovah said, Behold, they are one people, and they have all one language; and this is what they begin to do: and now nothing will be withholden from them, which they purpose to do. Come, let us go down, and there confound their language, that they may not understand one another's speech. So Jehovah scattered them abroad from thence upon the face of all the earth: . . ."

That confusion of many races and many languages has continued to this day and hampers all mankind. Language difficulties long have hampered the orderly developments of occupational medicine. This is exemplified in this excellent book. Here is a substantial text in the Italian language with contents that would be helpful to all industrial physicians if all were familiar with the Italian language. This comprehensive volume embraces all major occupational diseases but with emphasis upon the metals, the organic compounds, the dust diseases, the infectious occupational diseases, maladies caused by physical agents and postural affections.

While this text may not be recommended to those lacking the ability to use the Italian language, a grand opportunity exists for noting that advancement of occupational health by no means is limited to a few countries. Italy is outstanding in its contributions, and this book provides some proof of that statement. But Italy is not alone in this progression. Many may be astonished to learn of outstanding achievements in occupational health in Egypt, in India, in Israel, and in the South American states.

Even though Jehovah did scatter mankind upon the face of the earth and confounded language so that men might not understand other men's speech, a myriad of men in their respective languages in their writings are making superb contributions toward the conservation of industrial workers the world over.

Radioactivity in Man

George R. Meneely, M.D., Editor. $16.50. Pp. 491, illustrated. Charles C. Thomas, Springfield, Illinois, 1961.

This book records the results of a symposium on Radioactivity in Man conducted at Vanderbilt University School of Medicine, April 18 and 19, 1960, under the sponsorship of the Section on Medical Sciences of the American Association for the Advancement of Science, the Division of Biology and Medicine of the Atomic Energy Commission, the U. S. Public Health Service, and the U. S. Army Medical Research and Development Command. Forty-eight experts in this field, many of whom have made most significant contributions through their research, comprise the contributors to this volume.

While much of this symposium's effort is devoted to instrumentation used in detecting radioactivity in man, especially low level counting and its errors, a fair number of chapters are devoted to the impact that such acute and chronic exposures have in man, biologically, both now and in the future.

The areas of particular interest are in the chapters dealing with the industrial trends and requirements in the utilization of atomic energy, the legal sociological and ethical aspects of radioactivity and its hazards, and the Public Health Service's responsibility for radiological health control.

—VERNON N. DODSON, M.D.

Aerospace Medicine and Biology, Vol. III, 1954 Literature

Arnold J. Jacobius, Roman Kenk, Eugene Marrow, Ilga M. Plavnieks, Kristallo Voulgaris, and Leroy D. Davis, Editors. PB 171029. Pp. 542. $6.00. U. S. National Aeronautic and Space Administration, Washington, D. C., 1960.

(Vol. I, 1952 Literature. PB 121543. Pp. 204. $4.00. Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C., 1956.)

(Vol. II, 1953 Literature. Pp. 354. $5.00. Aerospace Medical Association, 2643 University Ave., St. Paul 14, Minn., 1959.)

When the arrival of this book was a promise and not a fact, joy ruled the prospective reviewer. When arrival became a fact this joy was chilled by the discovery that this compilation of abstracts is confined chiefly to 1954 with some further regression into 1953 and 1952. In those years aerospace medicine was but an embryo. Yet no reviewer is justified in belaboring a book if the purpose of the book is stated, if that purpose has been achieved and all together the publication is creditable. This book meets these requirements and in a fashion thus indicated in the text:

"In format, style, and arrangement, this volume follows closely the preceding ones. References are arranged alphabetically by author; abstracts are informative; and full bibliographic

information is provided, including foreign and translated titles, volume and issue numbers, place of publication (if foreign), inclusive paging, full dates, and library call numbers or other location symbols. While the bulk of the publication is devoted to journal articles, reports, and monographs published during the year 1954, items published in 1952 or 1953 not included in the preceding volumes have been incorporated in this volume. For quick identification, the publication years of these off-year references have been printed next to the first author's name. As before, cumulated corporated and secondary author and subject indexes are included, the latter being revised and enlarged considerably, in keeping with the over-all expansion of subject scope."

Still the wonder mounts that in the year 1961 the National Aeronautics and Space Administration as to annotated bibliography should be grubbing and groping in 1954. Good as it is for the purpose designed, this is no book for the average industrial physician. It is an essential as acquisition for every medical library. It is equally necessary for the "dyed-in-the-wool" medical astronaut. What is wanted right now is a similar compilation for 1960. The many omissions if necessary will be condoned anticipating their inclusion in the 1961 edition faintly expected by 1962. In summary: good, but too much lag.

Rehabilitation and World Peace, Proceedings of the Eighth World Congress of the International Society for the Welfare of Cripples, New York, August 28-September 2, 1960

Eugene J. Taylor, Editor. $2.00. Pp. 433. International Society for Rehabilitation of the Disabled, New York, 1961.

The February, 1961, issue of this Journal contained a Symposium devoted to selected papers before the Conference for which this book is the complete Proceedings. In that issue mention was made that the complete records in book form would become available. Orders may be directed to International Society, 701 First Avenue, New York 17, New York.

Disease and Injury

Leopold Brahdy, Editor. $12.50. Pp. 482. J. B. Lippincott Co., Philadelphia, 1961.

This book is unique but its uniqueness is not reflected in the title. The contents of this book are devoted to the circumstances under which a single traumatic injury may inaugurate disease states. This possibility is pursued with reference to all organs and systems. Answers to such questions as follow are provided:

Does a contusion of the breast cause or influence a malignancy?

Is there a causal relationship between extensive surface burns and duodenal ulcers?

Is there a connection between lifting during pregnancy and spontaneous abortion?

What particular physical stresses are detrimental to the cardiac patient?

May traumatic injury to the testes eventuate in sterility?

This is not a text book for day by day reading. Essentially it is for reference purposes, and in connection with many perplexing compensation situations it will prove invaluable.

Executive Retirement and Effective Management

Richard A. Beaumont and James W. Tower, Industrial Relations Monograph No. 20, Industrial Relations Counselors, Inc. $7.50. Pp. 248. The Haddon Craftsmen, Inc., Scranton, Pa., 1961.

Retirement of any worker from industry is no trifling matter. In the case of the executive who has long and ably served his company, retirement is a momentous affair.

"Retirement of executives on the basis of chronological age, rather than capability, is being increasingly questioned. Are valuable skills and knowledge discarded and ineffectiveness tolerated merely to accommodate uniform application of an arbitrary retirement age? This study of retirement policies and practices in 274 companies throws light on all aspects of the question. Company objectives and executive viewpoints are correlated in this volume to provide guides for management."

This book is addressed to management, but seldom is a high executive retired fully apart from some participation by the company's medical department. This book amply will serve the industrial medical director whenever he is called upon to share in the discussions of an executive's retirement.

Symptom Diagnosis

Wallace M. Yater and William F. Oliver. Fifth edition. $15.00. Pp. 951. Appleton-Century-Crofts, Inc., New York, 1961.

Some few physicians living on medical mountain tops deride this type of publication as representing only superficial medicine. Many times that number of physicians find in this text, now in its fifth edition, a starting point

in diagnostic procedure. For many physicians this book holds the same worth that *Merck Index* holds for chemists, industrial hygienists, and others. No chemist would claim that *Merck Index* is a complete chemical text. Equally so, no physician would rely upon *Symptom Diagnosis* as a complete system of medicine and such was never planned.

System by system, organ by organ, and symptom by symptom, brief information is furnished to serve as the initiation into more elaborate diagnostic procedures. Taking at random one subheading, "Swelling in the Floor of the Mouth," which falls under the larger category of "The Mouth or Buccal Cavity," the authors list six possible causations, namely: Ranula, Sialolithiasis, Dermoid Cyst, Carcinoma, Ludwig's Angini, Secondary Sialadenitis. Under each heading appropriate description is provided, thereby offering many leads toward an eventual precise diagnosis.

In any medical library this book will prove to be one of those that presents many signs of wear and tear, all reflecting endless use.

Surgical Diseases of the Chest

Brian Blades, Editor. $22.00. Pp. 580, 267 illustrations. C. V. Mosby Co., St. Louis, 1961.

This is a timely book extremely helpful to all doctors whose interests carry them into the broad domains of chest diseases.

Developments in our understanding of surgical diseases of the chest have been as dramatic and far reaching as any of the medical developments of this century. The authors of this book had to select carefully for detailed discussion what they considered the best and most important works, and they have ponderous reviews of many articles which seemed unimportant.

Despite the dramatic quality and genuine excellence of presentation, there are some areas that might be improved. For instance, the lymphatic drainage of the lungs could be embellished and correlated more with the scalene fat pad biopsy and the coin lesion as part of bronchogenic carcinoma is not given much discourse. The entire subject of bronchogenic carcinoma however, is concisely presented in a comprehensive manner as is the subject of pulmonary tuberculosis. Pleural biopsy as part of a diagnostic armamentarium should be mentioned. Traumatic rupture of the diaphragm could be given more attention. Cricothyroid membrane perforation in topical anesthesia for endoscopy is a controversial subject which could be deleted.

The sections presenting cardiac surgery are an excellent comprehensive discussion of the subject. They represent a great deal of well collated and digested experience. There is more detail in the surgical procedures dealing with cardiac pathology than there is in the operations for pulmonary diseases. One finds it regrettable not to see a detailed description of a segmental resection or lobectomy. Throughout the book there is an exhaustive bibliography following each chapter.

I enjoyed reading this book more than any other text on chest diseases and feel that it covers the subject more adequately than any book I have seen.

—W. A. WICHOWSKI, M.D.

Sleep Therapy in the Neuroses

B. V. Andreev. $8.50. Pp. 114. The International Behavioral Sciences Series, J. Wortis, editor. Consultants Bureau, New York, 1960.

The material collected in this monograph summarizes the extensive experience of the author and other Soviet research workers on sleep therapy. A concise presentation of historical development based on Pavlovian concepts of protective or restorative inhibition is followed by a clear, balanced review of the indications, methodology, and results of sleep therapy. The large Russian experience with this psychotherapeutic modality should prove valuable to the American psychiatrist. The book is a necessity for anyone using narcotherapy.

—LEO J. MIEDLER, M.D.

The Practitioner's Handbook

William A. R. Thomson, Editor. $12.50. Pp. 711. J. B. Lippincott Company, Philadelphia, 1961.

This book, with its British flavor, well states its purposes in this language:

"Comments such as these summarize admirably the aim of this book. It is not to purvey the latest news of the newest drugs. Rather is it to provide the general practitioner with an authoritative, concise and practical review of those methods of diagnosis and treatment which have proved acceptable and reliable in the hard school of clinical practice. The academic theorist may contend that the coverage is unbalanced, with too much attention devoted to diseases of women and children. This, however, is no academic textbook. It is, as the title indicates, a 'handbook' which lays the emphasis where it is encountered in general practice. Neither is it concerned merely with the cut-and-dried diseases so beloved of the textbook author. Here the problems discussed are those actually encountered by the general practitioner: "The child

who won't eat,' 'The child who won't walk,' 'The child who won't talk.' Equally typical of this new and practical approach to the problems of general practice is 'the use and abuse' series of chapters dealing, for instance, with purgatives in children, codeine, bromides, phenacetin and amphetamine."

Comparative Medicine in Transition

Henrik J. Stafseth, Chairman, Board of Editors. Pp. 499. The Lord Baltimore Press, Inc., Baltimore, 1960. A limited number of these books are available without cost on requests sent to the School of Public Health, University of Michigan, Ann Arbor, Michigan.

This book is the outgrowth of an Institute conducted at the School of Public Health, University of Michigan in Ann Arbor, October 6 to 9, 1958. The purposes and objectives of this Institute, as stated by the Planning Committee, were:

1. To explore, document and expand upon the present and future contributions of all veterinarians to human health.

2. To collect and evaluate source material on veterinary public health practices and administration.

3. To compile a publication on veterinary public health practice which reflects the thinking of the Institute, stimulated by the formal presentations and committee studies.

The interdependence between public health, clinical medicine, and the veterinary sciences is freely and widely recognized but there has been little fostering of this interdependence. This book is a portrayal of that interdependence. This is reflected in various chapter headings now listed:

Experimental Medicine
Biological and Pharmaceutical Production and Control
Food Hygiene
Occupational Health
Ecology
Military Veterinary Medicine
Radiation and Civil Defense.

In over-all appraisal it becomes apparent that veterinary medicine reaches into essentially all aspects of public health and much of clinical medicine. Outstanding is the impact upon occupational health. Approximately 150 diseases of animals may be transmitted to human beings, and without exception these zoonoses may arise in connection with occupational pursuits.

The committee of appraisal thus sums up the kinship between occupational health and veterinary medicine:

"All diseases in the zoonoses group should be considered as potential occupational hazards for persons engaged in the raising or handling of animals or animal products, and therefore subject to parasitism and infection. Public health veterinarians should assume responsibility for the detection, prevention, control, and reporting of these conditions. They should make data on the prevalence of such diseases in the community available to disease control agencies of state and local health departments for epidemiological investigation and for transmission to practicing physicians. For this purpose, close liaison should be established with the occupational health services of the official agency.

"Veterinarians engaged in meat and poultry inspection and animal disease eradication are in a favorable position to recognize, among plant employees, illness traceable to the zoonoses. Such information should be transmitted to state or local health departments for epidemiological investigation. Activities in occupational health, insofar as the veterinary profession is concerned, need not be limited to the zoonoses as such, but should extend into related fields. Specific areas are air pollution and other environmental hazards contributing to disease; toxic insecticides and pesticides; radiation; farm and meat plant construction equipment and operation in relation to accident prevention.

"Within the field of occupational health, the veterinarian has unlimited opportunity to serve the health of the community. His services are essential to a well-balanced team approach. Provided with adequate information and resource materials, the veterinarian could be used to advantage in 'grass roots' health education in this specialized area of public health."

INDUSTRIAL MEDICINE AND SURGERY

ESTABLISHED 1932

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August, 1961

VOLUME XXX

NUMBER 8

Carbon Tetrachloride Investigations

So many recent studies involving carbon tetrachloride have appeared in the literature that one might question our continuing need for research on such an old troublemaker. The history of carbon tetrachloride exposure in industry and in the home need not be reviewed. Improvement in vapor control methods and the substitution of less toxic solvents have greatly reduced the incidence of carbon tetrachloride exposure in the major industries. Why, then, the widespread research interest in carbon tetrachloride toxicity?

The obvious answer is that there are still too many unanswered and puzzling aspects to the mechanism of carbon tetrachloride toxicity. First, the complete metabolic fate of carbon tetrachloride is not known. Studies using radioactive carbon tetrachloride have not only allowed us to establish a more reasonable maximum allowable concentration (MAC) of 25 ppm, but have also outlined the fate of the major portion of inhaled carbon tetrachloride. As might be expected, the major portion of inhaled carbon tetrachloride is exhaled unchanged. However, this is not the whole story. When radioactive carbon tetrachloride was inhaled by monkeys, radioactive carbon dioxide was exhaled. This indicates a tissue mechanism for the dehalogenation of carbon tetrachloride and the release of carbon dioxide. What intermediates might be formed during the dehalogenation process? Could such intermediates released intracellularly be partly or wholly responsible for the toxic action of carbon tetrachloride? An unidentified metabolite of carbon tetrachloride, apparently a conjugate of some type, was also found in the urine during these studies. Thus the metabolic pathway and the relationship of metabolism to toxicity remains to be clarified.

With respect to tissue damage, the major emphasis has been placed on the liver and, in fact, carbon tetrachloride has become a common means of producing liver damage for experimental purposes. A number of recent papers has confirmed and expanded early studies on the relationships between carbon tetrachloride exposure, liver damage, and serum enzyme levels. Such studies are based upon the assumption that damaged tissues release a variety of enzymes into the blood stream. Since enzymatic activity in blood serum is generally low, slight tissue damage releasing relatively large amounts of enzymes can increase blood enzyme levels many fold. Specific serum enzyme levels of rats exposed to carbon tetrachloride vapor may be 50

to 100 times the control levels 24 hours after exposure. These elevated serum enzyme levels usually return to normal within two to three days after such an exposure, thus the utilization of serum enzyme levels as a means of detecting liver damage may be limited to a relatively short period of a few days following exposure. Further studies are needed to detect more specific tissue enzymes and to clarify the time relationships between tissue damage and elevated serum enzyme levels. Since many serum enzyme determinations are relatively simple to perform, such investigations ultimately may lead to simple reliable tests for subclinical levels of toxicity, not only for carbon tetrachloride but for other materials having a similar mode of action.

The fatty liver that develops rapidly after carbon tetrachloride exposure has been the subject of a number of investigations. Several reports have suggested that the development of fatty liver and liver necrosis as a result of carbon tetrachloride exposure are two separate phenomena. Thus both the actual development of fatty liver and the relationship of fatty liver to tissue damage are areas requiring further investigation.

Alterations in the enzymatic activity of the mitochondrial fraction of liver cells of exposed rats have also been reported. The relationship of these enzymatic changes to the tissue pathology that develops is still in the developmental stages.

More recent reports have demonstrated a remarkable relationship between carbon tetrachloride toxicity and the central nervous system. Rats with the spinal cord sectioned prior to carbon tetrachloride ingestion were completely protected against the toxic effects of carbon tetrachloride as measured by fatty liver development and serum enzyme changes. This has been interpreted as suggesting that liver damage due to carbon tetrachloride is the result of a massive adrenergic discharge leading to centrilobular liver anoxia and a resulting necrosis.

The research activities now being directed toward carbon tetrachloride toxicity are not due alone to the hazards associated with carbon tetrachloride but rather to a desire to understand the basic mechanisms by which such a material brings about its toxic response. These studies of carbon tetrachloride toxicity might well serve as a stimulus for profitable investigation into the biochemical mechanisms involved in the toxicity of many other industrial solvents.

—HERBERT H. CORNISH, Ph.D.
Department of Industrial Health
School of Public Health
University of Michigan

Seat Belts For Automobiles

Consumers Union, Mount Vernon, New York, makes this report with respect to seat belts for automobiles:

The recent agreement by automobile manufacturers to provide built-in attachment points for seat belts in 1962 cars is a welcome step in auto safety, in that it will provide a strong impetus to public acceptance of seat belts. This achievement can be credited to the persuasive efforts of the U. S. Public Health Service, the American Medical Association, the National Safety Council, the American College of Surgeons, several state legislatures, and other organizations and individuals concerned with traffic safety. Consumers Union also has been supporting the use of seat belts (and testing them) for several years.

Despite the appropriateness of welcoming this development, Consumers Union believes that there is a possibility that it may backfire and eventually damage the cause of seat belts and of other safety measures. In order to avoid this contingency, it behooves the proponents of seat belts to take a sober look ahead, to recognize and pass along to the public some realistic perspectives on the matter. These include:

(1) The benefits to be derived from the installation of belt attachment points are entirely dependent on the public's cooperation in buying and using seat belts.

(2) The scientifically established facts* about the effect of seat belts in controlling death and injury are these: belt users are just as likely to be hurt in accidents as non-users of belts, but belt users are likely to sustain injuries of a less severe nature; in comparable accidents, belt us-

*Automotive Crash Injury Research of Cornell University is the only group in the U. S. to have collected and analyzed massive statistical data on actual accidents involving seat belts. The pertinent ACIR studies furnishing information relative to seat belt effectiveness are: *Safety Belt Effectiveness in Rural California Automobile Accidents*, by B. Tourin and J. W. Garrett, Feb., 1960, and *Ejection and Automobile Fatalities*, by B. Tourin, May, 1958. Earlier reports from the same Cornell group, furnished in Congressional testimony in 1956 and 1957, made more optimistic estimations of seat belt effectiveness.

ers experience about 35% fewer serious injuries than non-users; aside from "off-the-cuff" opinions and the judgments of clinical observers, there are no conclusive data with respect to fatalities — but carefully qualified predictions based on large-scale studies *suggest* a reduction in fatalities of 25% to 50%.

(3) Even though the *individual* using a seat belt can reduce his own risk of severe injury by about 35% and might reduce his own risk of death by anywhere from 25 to 50%, the *national* highway fatality toll would reflect this much reduction *only* if *all* cars, old and new, have seat belts for all passengers, and the belts are used.

(4) It follows that even if all 1962 cars (but only 1962 cars) were to be equipped by their owners with belts for the anchors provided, and if 1962 cars were to be 10% of the cars on the road in 1962, the over-all reduction of severe injuries could be no more than 3.5% (10% of 35%) and the over-all reduction of deaths would be likely to be no more than about 2.5 to 5.0% (10% of 25%, 50%).

Clearly, then, under the most favorable conditions, we cannot expect even as much as a 5% improvement in the over-all picture from the seat belt attachment points in the 1962 cars.

The public, however, has been blithely led to expect (by recent newspaper reports) that the seat belt anchors will lead to a reduction of injuries and/or deaths by as much as 50% or 60%. We therefore must consider the possibility that widespread disillusionment with seat belts may result in 1963, if the touted 50% or 60% turns out to be in the order of 3 to 5%. Public acceptance of seat belts, and of other safety measures, may thereby receive a body blow.

It is therefore imperative that all responsible organizations and individuals who appreciate the value of seat belts intensify their efforts to (1) persuade the public to install seat belts in *all* cars and to use them; (2) clarify in more realistic terms the degree of improvement which can be expected; (3) educate the public to recognize its own role in determining the size of the improvement.

Consumers Union believes that one further step should be undertaken, as well. This proposed step is based on the need to demonstrate to the public any real improvement resulting from their use of seat belts. Since the improvement at first may be small, and may be easily masked by other changes operating in the automotive safety field, it will be necessary to conduct careful studies during this crucial period when seat belts may rise or fall. We therefore suggest that steps be taken before 1962 to lay the groundwork for suitably valid studies.

Highway patrols and state motor vehicle bureaus should be encouraged now (by whatever legislative authority and fiscal means which may be necessary) to collect data on the presence and use of seat belts in cars (*at least* those involved in accidents). Reports on the severity of injuries should also be obtained. Techniques such as those already developed by the Cornell Automotive Crash Injury Research program should be utilized fully, and expanded in whatever way may be possible.

Consumers Union urges all organizations and individuals interested in the use of seat belts to take appropriate action to promote such statistical studies as an essential need. The recently publicized figure of a saving of 19,000 lives per year by the projected use of seat belts documents the need for valid statistics and their appropriate interpretation.

For several years experts have estimated that seat belts may reduce fatalities by 50%, but furnished no supporting statistical evidence. Cornell, in 1960, showed a 50% reduction of fatality among a massive sample of seat belt wearers in accidents — but cautioned that the fatality data on which this figure was based were *too sparse for statistical significance* (among the 10,000 automobile occupants studied there were only 65 deaths, of both users and non-users of belts).

It is apparent that some over-enthusiastic supporters of seat belts have seized this 50% estimate and applied it to the 38,000 deaths seen annually. Thus they concluded that a saving of 19,000 lives is possible. Furthermore, they failed to take into account that some 16,000 of the 38,000 fatalities are pedestrians, bicyclists, and occupants of trucks and busses.

In whatever areas statistically significant data are not available, this should be recognized and steps taken to obtain the necessary data. One of the reasons for the sparseness of data in the past has been that too few people have had seat belts to make a detailed study feasible. This situation makes it incumbent on safety-minded organizations and individuals to promote (1) the accumulation of more data at a time when more people will be using belts, and (2) the statistical study of the data, lest the general public suffers an unwarranted disillusionment.

It is also the view of Consumers Union that the promotion of other passenger protective features — such as built-in crash paddings, better door locks, and recessed hub steering wheels — should not be neglected during the period of upsurge in public interest in seat belts. Consumers Union will continue to advocate further development, testing, and use of all such devices.

Simultaneous Discovery and Invention

It is not remarkable that two or more persons, unknown one to the other and far apart in miles, should come to the same and accurate scientific conclusions on important matters at about the same time. What is remarkable is that this phenomenon does not occur more frequently. Yet the frequency in medicine alone has been sufficient to engender some bitter controversies. For example, who was the first to apply ether as an anesthetic? One of these near simultaneous disclosures has to do with the discovery of Adrenalin, more precisely known as Epinephrine. This story has numerous variations all of which are partially true, but it is unlikely that any one is exactly true. This story needs retelling for every new generation of physicians.

Long before the discovery of the active principle of the medullary portion of the suprarenals and as early as 1894, it was well known that the crude extract of the suprarenal contained a pressor property. This was first established by a general practitioner in England named Oliver. This physician brought this finding to the attention of Dr. E. A. Schafer of University College in London. Dr. Schafer may have been more than skeptical, he may have been scornful. No less he consented to the demonstration by Dr. Oliver and engaged in the preparation of a dog experiment for the recording of vascular effects. "So Professor Schafer makes the injection, expecting a triumphant demonstration of nothing, and finds himself standing 'like some watcher of the skies, when a new planet swims into his ken,' watching the mercury rise in the manometer with amazing rapidity and to an astonishing height. . . ." That astonishing demonstration marked the beginning of the quest for the isolation of the active agent in precise crystalline form.

By 1897 Abel and Crawford, at Johns Hopkins University, had made such progress that the active principle had been reduced to a polybenzoyl derivative which was far from a chemically pure state. This was made more active by treatment with dilute sulfuric acid. In 1899 Abel came forth with the empirical formula, C_{17} H_{15} NO_4. This proved to be inaccurate as an empirical formula for what later was named "Adrenalin." A year later the Japanese chemist Jokichi Takamine visited Abel's laboratory at Johns Hopkins. Takamine is better known to the general public as the one who brought to Washington the first Japanese cherry trees. The generous Abel disclosed all of his findings to Takamine who at once expressed the opinion that it would be easy to produce a purer product. In his own laboratory Takamine in this belief set about this project. There are some persons of the period who were willing to believe that Takamine engaged in some scientific shoplifting.

At the same time and for some years previously, Thomas Bailey Aldrich, not the famous American writer but instead the chemist, had been working on this same project at the biological research laboratory of Parke, Davis & Company in Detroit, Michigan, and was as close to the solution of the chemical enigma as either Takamine or Abel. In the year 1901 all three of these workers without any collaboration in their effort were hot on the trail of the exact chemical nature of this hormone. That was the critical year, and all three of these investigators moved in different directions. Abel was the pure scientist and was eager for the disclosure of the exactness of a major medical discovery. Aldrich was the product man and was fully ready to deliver into the hands of his employers a highly purified form of suprarenal extract. At that time Aldrich stood high on the chemical pedestal in his company's research program. Just at the moment of Aldrich's triumph all was swept away when Takamine appeared on the scene with a patent for a crystalline product which later proved to be not quite pure for which he had coined the term name "Adrenalin." At one moment the manufacturer stood ready to acclaim Aldrich and to market his remarkable wares. In the next moment this triumph was shattered by Takamine and his patent. Long after this beginning it was common talk that Takamine's patent rights on Adrenalin averaged $75,000 yearly for its lifetime.

John J. Abel long has been acclaimed as the discoverer of Adrenalin, which is not wholly true although the *Encyclopaedia Britannica* makes this statement: "Two of Abel's contributions to medical science were the isolation of Adrenalin and the isolation of Insulin in crystal form." Actually Abel did not even coin the term Adrenalin. Abel won the scientific glory. Takamine won the financial returns. But what of Aldrich? His reward chiefly was frustration, and yet it was Aldrich in 1905 who for the first time produced the highly purified crystals of

Adrenalin and first assigned the true empirical formula which turned out to be $C_9 H_{13} NO_3$. The truth is that the real hero of the matter as to chemical exactness is Aldrich. But for him, only mountains of frustration since the Takamine patent still held as valid.

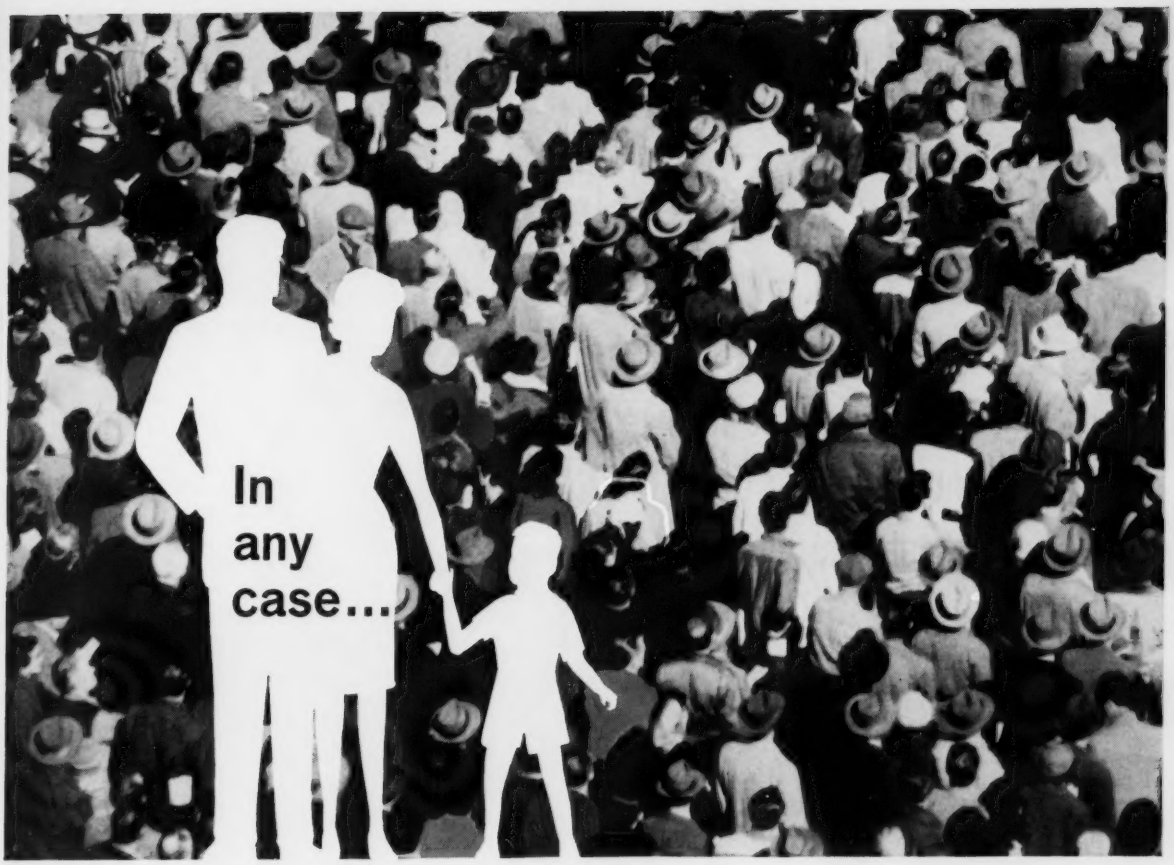
How is it that this editorial writer is even a little familiar with these matters? Thomas Bailey Aldrich, the frustrated chemist, became Thomas Bailey Aldrich, the unfrustrated sailor, and this editorial writer was the one-man crew on the Aldrich cat boat, "The Ethel." This in part is the Aldrich version of the famous simultaneous discovery of Adrenalin.

Menstruation and Accident-Proneness

Normal menstruation in industrial workers should occupy no prominent place in the medical program. Psychogenic influences frequently lead to an exaggeration of the importance of this physiologic phenomenon. Notwithstanding, there are a few indications that the menstrual period may involve states of mind and body on the fringes of the pathologic. A new development relates menstruation to accident-proneness. Katharina Dalton, writing in the *British Medical Journal*, (Nov. 12, 1425, 1960) summarizes her statistical investigations of menstruation and accident-proneness in this language:

> In this survey 44 (52%) of a total of 84 regularly menstruating women were involved in an accident during menstruation or the four days before menstruation. The significance of menstruation as a factor affecting accident-proneness persisted among home, road, and factory accidents, while women were performing routine actions, and among the active and passive participants of an accident. It is suggested that the increased lethargy of menstruation and the premenstruum is responsible for both a lowered judgment and slow reaction time. Schoolgirls' work deteriorates during menstruation, and they are more likely to be punished for unpunctuality and forgetfulness during menstruation. It has been found that the intelligence-test scores in women Army personnel were lowered during menstruation, but surprisingly, this did not hold for the practical/mechanical performance test.

These findings cause one to consider the wisdom of administering tranquilizers for premenstrual tension, which may well increase accident-proneness at the most dangerous time of the menstrual cycle. One wonders if awareness by women that they are more accident-prone at certain times of the month will enable them to use greater care in avoiding accidents, or will it merely induce a menstrual neurosis?



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Descriptive literature and directions for use available in Physicians' Product Brochure No. 81 from G. D. Searle & Co., P.O. Box 5110, Chicago 80, Illinois.

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Reference: 1. Hardy, James D.: The Nature of Pain, J. of Chronic Diseases, Vol. 4, July, 1956.

WHITEHALL LABORATORIES, NEW YORK, N. Y.

COMMENT AND OPINION

Uranium Mining Hazards

The Public Health Service has announced the release of a new publication which reveals serious health hazards in uranium mining and urges more aggressive action to meet the danger. The report summarizes the proceedings of the Governors' conference on health hazards in uranium mines held last December, a meeting attended by officials from the seven western states engaged in uranium mining. In spotlighting the problems of uranium miners, the conference revealed that, among these workers, deaths are occurring in excessive numbers due to lung cancer and to complications of silicosis.

Since 1950, the Public Health Service, the Atomic Energy Commission and the cooperating states have examined a total of 3,317 uranium miners with varying periods of exposure. Among 907 white miners with more than three years of underground experience from this group, there were three statistically significant causes of death: heart disease with cor pulmonale up to 17.8 times the expected rate; respiratory cancer, nearly five times; the non-automobile accidents, about four and one half times what may be expected.

In 1957, triennial medical examinations included for the first time an analysis of the sputa for cancer cells. The technique used (Papanicolaou) is similar to that for the detection of cancer of the cervix. Of the 1,075 miners examined, the responses of 1,061 were essentially negative; 13, or 1.2% were doubtful; and one, or 0.09%, was positive. In 1960, 1,788 miners were examined with this technique. As of December 9, 1960, reports were available on the first 272. These included 230 negative; 33, or 12.2%, in the doubtful class; and 9, or 3.3%, positive.

The rise from 1957 to 1960 in the doubtful and positive classes cannot be explained by variations in the technique used. Its ultimate significance remains to be determined. Cytologists have found, in other population groups examined with this technique, that those in the class considered positive have at least an 80% chance of having bronchogenic carcinoma. They indicate that the percentage in the doubtful category is considerably less, estimates ranging from 20% to 60%. Discussion with health officers has emphasized the importance of organizing a careful followup of the men showing positive findings.

In 1959, environmental studies were made of 371 underground mines with 3,619 miners to evaluate the extent of the radiation hazard. Thirty-three percent of the 1,802 samples taken of the mine atmosphere had concentrations of less than one times the working level (a level of radiation exposure which it is thought may be maintained over a working lifetime without causing biologic damage); 22% had

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Biological
Testing Proves

the Virtual Absence
of Toxicity in
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PHASE I: Groups of Swiss mice received daily injections of Go-Jo Creme Hand Cleaner.[2] After seven days, body weights were recorded and the animals of one group sacrificed for gross pathology. The remaining animals received injections for three weeks and then were sacrificed and autopsied. The absence of mortality, weight loss, change in organ weights and gross pathology evidenced Go-Jo Creme Hand Cleaner's virtual freedom from systemic toxicity.

PHASE II: Albino rabbits were grouped and their flanks shaved. The experimental group was further divided, and the skin of one subgroup was abraded. For two weeks the subjects received daily applications of Go-Jo Creme Hand Cleaner. After a thirty-day observation period the animals were sacrificed and autopsied for gross pathology. Specimens of control and treated skin underwent histological examination for the appearance of pathological changes. The virtual absence of gross and microscopic pathology following prolonged topical application evidenced Go-Jo Creme Hand Cleaner's relative freedom from dermal toxicity.

The tests confirmed
the virtual absence of subacute or chronic dermal or systemic toxicity and established the relative safety and freedom from toxic irritants of Go-Jo Creme Hand Cleaner.

1. Methods recommended by The Association of Food and Drug Officials of the United States for the appraisal of the safety of chemicals in foods, drugs and cosmetics.

2. Cans of Go-Jo Creme Hand Cleaner were obtained from retail supplies and pooled. This pooled sample was used in all tests.

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between one and three times the working level; 23% had between three and nine times the working level, an increase of 2% over the preceding year; and 22%, 4% more than in 1958, had concentrations of more than 10 times the working level.

Continuing investigations are being made to spur dilatory compliance with recommended measures to control radiation exposures in the mines. There are at present nearly 1,000 active underground uranium mines in the Western United States. It is believed that in virtually all uranium mines radioactive contamination can be controlled, and that the means of control is practicable. Determination of the means of control applicable to each mine can be determined only by individual study.

The report concludes that mounting evidence of the severe health hazards in uranium mines points out the urgency for more aggressive action to meet the problem. Control of these hazards was viewed by the Conference participants as a primary responsibility of the states. Upon request, various agencies of the Federal Government stand ready to provide assistance to the states in carrying out this responsibility.

A copy of the publication, *Governors' Conference on Health Hazards in Uranium Mines, A Summary Report*, Public Health Service Publication No. 843, may be obtained from the Public Health Service, U. S. Department of Health, Education, and Welfare, Washington 25, D. C.

A Safe Investment

Do driver training programs pay off? The Arizona Public Service Co. of Phoenix says yes. The utility reports accidents and insurance costs were reduced as a direct result of its program. In 1954, with 400 to 500 company vehicles in operation, insurance premiums were slightly more than $19,000, and losses came to more than $43,000. The company inaugurated a driving training program in 1955. With 1,000 vehicles operating in 1959, insurance premiums were $23,268, while incurred losses dropped to $10,751. At present, the company's insurance figures show a further decrease in losses even though there has been an additional increase in its truck fleet.

Drivers are thoroughly tested for speed of reactions, depth perception, eyesight, knowledge of their vehicles and driving regulations. In addition, a driver training specialist rides with each driver on a road test. If physical defects are uncovered, the driver goes to the company clinic for consultation and advice. More than 1,000 drivers, including salesmen, supervisors, and managers who drive their own cars, have been tested. At the year end safe-driver awards are made to accident-free drivers.

—*Industrial Relations News*, May 20, 1961.

The Winners

The Lammot du Pont Safety awards, highest honors given for improvement in chemical manufacturing safety, were presented to the Escambia Chemical Corp. and the Chemical and Metallurgical Division of the General Electric Co. The two companies were honored in June during the 89th Annual Meeting in Washington, D. C. of the Manufacturing Chemists' Association which administers the awards.

The Lammot du Pont Safety awards are presented each year to the two companies which show the greatest percentage of reduction in their average disabling injury frequency rate for the past two year period, compared to their rate for the immedi-

VALUE

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*Edelstein, A. J.: Pennsylvania M. J. 62:1831 (Dec.) 1959.

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ately preceding three years. One award is presented in the category consisting of companies with less than two million man-hours of annual work time and another in the category consisting of companies exceeding two million man-hours of work time annually.

Mr. R. U. Haslanger of Escambia Chemical received the plaque for his company as the winner in the under two million category, and Dr. A. E. Schubert received the award for General Electric, winner in the two million or more category. The awards first were sponsored in 1950 by the late Lammot du Pont, an officer of E. I. du Pont de Nemours & Co., who undertook this means of honoring outstanding safety achievement as a personal project.

In winning the award in the larger company category, General Electric reported an injury frequency rate for the years 1959-60 of 1.685, a reduction of 61% from the 4.362 rate of the preceding three years.

Escambia Chemical, winner in the smaller company category, reported an injury frequency rate for 1959-60 of 1.525, a reduction of 79% from the rate of 7.287 during the three prior years.

Announcing the names of the two award winners, Mr. J. S. Queener of DuPont, chairman of MCA's General Safety committee, said, "No industry pays more attention to safety than does the chemical industry. Though we can never be satisfied with our achievements, it is gratifying to note the marked advances of the past decade."

Don't Sit Under the Sycamore Tree

The fungus which causes histoplasmosis, a frequently serious lung disease, has been found for the first time in Washington, D. C., according to the Public Health Service.

The fungus, Histoplasma capsulatum, was found in soil contaminated by starlings taken from beneath sycamore trees in two of Washington's parks. Hitherto, many investigators have believed that the fungus grew only in the soil of rural areas and small towns. The findings, by Dr. Chester W. Emmons, Chief of the Medical Mycology Section of the National Institute of Allergy and Infectious Diseases, are described in the June issue of *Public Health Reports*, a publication of the Public Health Service.

Past reports by Dr. Emmons and other scientists have indicated that droppings from some species of wild birds as well as from domestic fowl create a soil condition highly suitable for the growth of the fungus. Man is infected by inhaling contaminated soil or dust.

Dr. Emmons was searching primarily for the agent of another serious fungal disease, cryptococcosis, which has been isolated many times from Washington areas contaminated by pigeon droppings.

Referring to the site of his latest findings, Dr. Emmons points out in his report that "the park had been periodically and recently cleaned and there was

no obvious contamination with bird excreta, although it is known that the soil under the sycamore trees where the collections were made is regularly contaminated with such material. It is obvious that roosting starlings can create a soil environment suitable for the growth of Histoplasma capsulatum even though bird excreta do not accumulate and remain on the surface of the soil."

The report emphasized that other scientists also have suggested "an urban type of human exposure" to histoplasmosis and notes that histoplasmosis is already well-documented as "an important medical problem in Washington, D. C., and surrounding areas." In certain Maryland and Virginia communities, the report says up to 83% of the population have shown evidence of past exposure to the disease.

The Disappearing TB Threat

Through more intensive use of modern control measures, particularly drug therapy, tuberculosis can be virtually wiped out in the United States, according to statisticians of the Metropolitan Life Insurance Company. The death rate from the disease in 1960 dropped to an all-time low of six per 100,000 population, only slightly more than one fourth of what it was 10 years ago.

In the decade from 1946-48 to 1956-58 the tuberculosis death rate among males at all ages combined dropped 75%, while females have enjoyed an even more favorable record. Progress has been particularly rapid in childhood and early adult life, where decreases in the death rate from the disease have ranged up to 97% at ages 15-24.

In later adult life the improvement in tuberculosis mortality has not been as large, particularly among older men. Among white men 65-74 years of age the mortality reduction was a little over 50%.

Geographically, every state in the country has shown large decreases in tuberculosis mortality during the decade, ranging from 66% in Arkansas to a high of 85% in Washington. In 34 states, the reduction amounted to 75% or more.

What Does She Do?

The Occupational Health Nurses Section of the American Nurses Association has published two brochures which are of interest to industrial medical personnel. *An Employer Asks Some Questions* states the specific composition, purposes and functions of the Occupational Health Nurses Section in addition to providing basic information about the American Nurses Association, and *Functions, Standards and Qualifications for Occupational Health Nurses* contains a description of occupational health nursing based on present practice as well as emerging patterns.

Both brochures may be secured at no cost from the American Nurses Association, 10 Columbus Circle, New York 19, N. Y.

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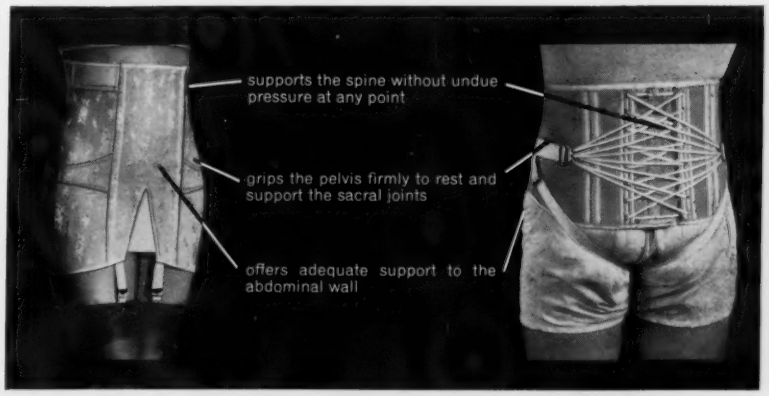
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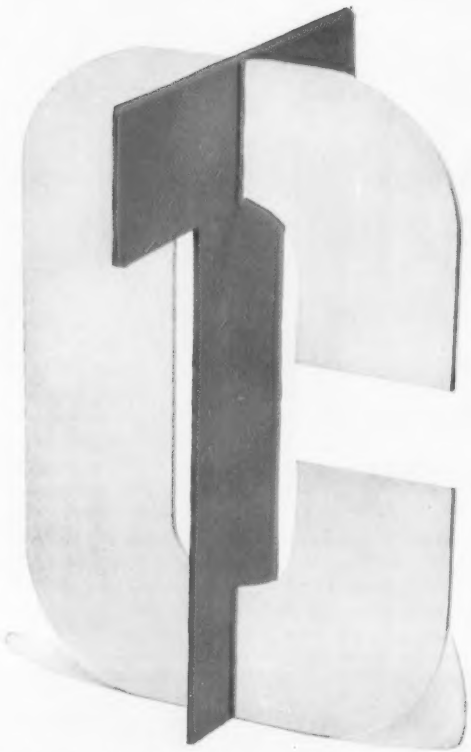

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Eye/Ear Suspension – *Ocular Conditions:* 1 or 2 drops into the affected eye three times daily. *Otic Conditions:* In external ear canal disorders, 2 to 4 drops three times daily, or as required. Keep dropper out of contact with infected area. In eye/ear infections that are deep-seated or spreading, systemic therapy should be employed concurrently.

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Supplied: Topical Ointment – In 1/6-oz. (5.0 Gm.) and 1/2-oz. (14.2 Gm.) tubes, containing 3% oxytetracycline (Terramycin®) hydrochloride and 1% hydrocortisone (Cortril®) alcohol in each gram of petrolatum base.

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References: (1) Morrison, W. H.: *Nebraska M. J.* **45**:106, 1960. (2) Perkins, E. S.: *Practitioner* **178**:575, 1957. (3) Tassman, W. S.: *U. S. Armed Forces M. J.* **10**:161, 1959. (4) Kamiya, S.: *Am. J. Ophth.* **42**:269, 1956. (5) Holland, R. W. B.: *Arch. Ophth.* **57**:214, 1957. (6) Benton, C. D., Jr.: *South M. J.* **51**:1562, 1958. (7) Blakiston's New Gould Medical Dictionary, ed. 2, New York, McGraw-Hill Book Company, Inc., 1956, p. 945. (8) Ostler, H. B., & Braley, A. E.: *J. Iowa M. Soc.* **44**:427, 1954.

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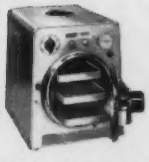

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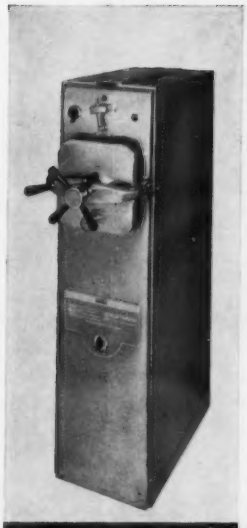

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